

## **Dynamic Real Time MRI for Analysis of Vocal Tract in Different Musical Theatre Singing Styles**

*Objective:* It has been shown that dynamic MRI is a useful tool to study vocal tract shapes and associated modifications in different register conditions in classical western singing and yodelling. However, also in musical theatre singing different techniques show differences in sound characteristics which could be associated with differences in vocal tract shapes.

*Material and Methods:* Dynamic real time MRI of 8 frames per second was used to analyze the vocal tract profiles in a single female musical theatre singer. The subject was asked to perform different singing tasks, such as register changes, different vibrato styles and different singing styles which are commonly used in musical theatre singing.

*Results:* Different tasks including belting function show differences of vocal tract shapes concerning lip opening, jaw opening, tongue position, pharynx width, uvula elevation, larynx height and tilting of the larynx.

*Conclusions:* The differences of the vocal tract configurations might contribute to differences in sound characteristics observed in different vocal conditions used in musical theatre singing.

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## The Effect of Cheek Supports on Aerodynamic Measurement Precision During the Airflow Interruption Technique

Airflow interruption provides an accurate, indirect estimation of subglottal pressure ( $P_s$ ). Measurement of  $P_s$  is essential for calculating laryngeal resistance ( $R_L$ ), vocal efficiency, and phonation threshold pressure. We have observed that the interruption sometimes causes cheek expansion, potentially reducing measurement precision. This phenomenon also occurs in respiratory studies using a similar method to measure airway resistance and is counteracted by supporting the subject's cheeks during the interruption. To determine if cheek expansion affects measurement of aerodynamic parameters and measurement precision, we tested eight subjects performing ten trials with and ten trials without cheek supports. Task order was varied to ensure any potential difference in performance was not due to comfort level with the experiment. Mean and coefficient of variation of mean flow rate (MFR),  $P_s$ , and  $R_L$  were calculated for each subject and condition. Paired t-tests or Wilcoxon Signed Rank tests were performed to compare results obtained with and without cheek supports. Cheek supports had no effect on mean estimation of MFR ( $p=0.250$ ),  $P_s$  ( $p=0.641$ ), or  $R_L$  ( $p=0.454$ ). Coefficients of variation for MFR and  $P_s$  were lower when using cheek supports, but neither difference achieved statistical significance ( $p=0.065$ ,  $p=0.092$ ). Cheek supports had no effect on the precision of measuring  $R_L$  ( $p=0.518$ ). From these results, we cannot conclude that cheek supports either should or should not be incorporated as a standard component of airflow interruption. Given the modest sample size and nearly significant differences in measurement precision, though, cheek supports may be a valuable addition. Additional subjects will be recruited to determine if this apparent difference is upheld in a larger sample size.

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## Analyzing the Female “Middle Register” with EGG Wavegrams

The choice of singing register and the degree of vocal fold adduction are two concepts that are not easily discriminated by inexperienced singers. This is particularly true for the mid range (pitch C4 – C5) of untrained female classical singers, where adducted falsetto, the desired sound quality in this range, is rarely observed. As an underlying physiological principle, vocal fold adduction can be separately controlled by (a) *cartilaginous adduction*, i.e. the adduction of the posterior glottis via the arytenoids (controlled by the singer with the degree of “breathiness” / ”pressedness”); and by (b) *membranous medialization* through vocal fold bulging (controlled by the choice of vocal register, i.e. chest vs. falsetto) [1].

In this study, singing exercises and instructions for adjusting adductory settings (cartilaginous adduction vs. membranous medialization) in the female mid-range were performed by both trained and untrained female classical singers. Phonation was monitored by acoustic recording, electroglottography (EGG) and laryngeal imaging. *EGG wavegrams* [2], a novel method for displaying EGG signals, were used for data analysis.

EGG wavegram data revealed distinct differences between the targeted phonation types for each individual. The observed differences established themselves as (a) presence/absence of vocal fold contact; (b) duration of vocal fold contact per glottal cycle; (c) changes in the overall EGG signal amplitude; (d) distinctness of opening/closing events; (e) perturbations seen in the wavegrams. Inter-subject data variation suggests that the individual’s anatomy influences vocal fold contact in singing. EGG wavegrams proved to be useful in documenting changes of both singing register and glottal adduction.

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## Videokymography: Which Features Can Be Reliably Evaluated Visually?

Videokymographic (VKG) imaging has been accepted as a novel convenient method of displaying the phonation behavior of the vocal folds. Clinicians use the method to visually evaluate various vibration features of the vocal folds, which are relevant for diagnosis of voice disorders (Svec et al. 2007). The present study addresses the question of how reliable is the visual evaluation of these features.

Ten judges evaluated 33 VKG features in 50 VKG images from patients of various voice disorders using an original systematic protocol. Simplified drawings (pictograms) were used for each of the features to make the evaluation easier.

The results revealed that 10 features were evaluated identically (within the expected tolerance region) in over 95% of the cases. These most reliable parameters were: presence of vibration on the left and right vocal fold, closure duration, left-right frequency differences, problematic evaluation, number of cycles left and right, view obstruction, vibration variability left and right. 10 more parameters were evaluated identically in over 90 % of the cases and the rest of the parameters in over 72% of the cases. The least reliable parameters were: interference with fluids, axis shift during closure, mucosal wave type and type of cycle aberrations.

These results provide the basis for evaluating algorithms for automatic detection of the vibration features of the vocal folds based on image analysis. The analyzed videokymographic features provide important information on vocal fold functioning which is complementary to the traditional information on laryngeal morphology obtained from laryngoscopy and laryngostroboscopy

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## **Crude Vibratory Profile of High-Speed Videoendoscopy Data and Its Applications**

High-speed videoendoscopy (HSV) captures details of the vocal fold and its vibratory characteristics. For quantitative analysis, however, it typically requires lengthy computer-aided data processing to extract vocal-fold features. This presentation will describe a quick and effective method to extract vocal-fold vibrational characteristics from HSV data. Our feature signal, crude vibratory profile (CVP), is extracted directly from HSV video frames without performing costly glottis detection, which usually is the initial step in quantitative analysis.

During the phonation, the only source of fast change in HSV data is the glottal vibration. Other sources of changes include camera motion, fluctuation of light intensity, and obstruction of glottal visibility by epiglottis or other supralaryngeal structures. These other sources, however, produce much slower change than the glottal vibration. The CVP is aimed to emphasize the fast vocal fold vibration and deemphasize the other changes in the video. The CVP value is computed for every video frame as the sum of the minimum pixel intensity values of rows of the video frame. The vibratory characteristics obtained from CVP can be seen as a noisy version of the one obtained from the glottal area after segmentation. The vocal fold vibratory characteristics are well portrayed in the CVP, given clear view of the glottis throughout the video with minimal camera movement.

Possible applications of the CVP include quick assessment of vocal-fold vibration via spectrogram, estimation of the fundamental frequency (which also enables the 3-D segmentation technique), automatic phonation detection, and automatic glottis location.

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## **The Required Speed of High-Speed Videoendoscopy for Specific Clinical Voice Assessment Protocols**

The increased interest in the clinical implementation of high-speed videoendoscopy (HSV) for voice assessment and laryngeal evaluation warrants the need for establishing technical requirements that fit the specific clinical needs. Some literature sources have suggested that insufficient HSV frame rates can adversely impact clinical decisions. We presented preliminary data based on visual-perceptual assessment suggesting that HSV frame rates affect separate clinical-protocol components to a different extent. We also presented evidence of the impact of frame rates on objective HSV measurements. This study involved two stages. Stage one was a revision of our previously-reported visual-perceptual study, re-designed to improve intra- and inter-rater reliability. Based on 48 samples from a large 16,000-fps HSV database recorded at various pitch, register and vocal-effort behaviors, we established that the features of mucosal wave magnitude and extent were most affected by lowering the HSV frame rates amongst all other studied clinical features: amplitude and phase asymmetry; glottal area aperiodicity; glottal edge roughness; realization and loss of vocal-fold contact; and mucus bridges breaking at opening. Stage two was aimed at establishing the factors, i.e. fundamental frequency, phonatory behavior, gender and pathology, which influence the HSV speed requirements. We used a randomized visual-paired comparisons design to establish the rates at which: a difference was first noticed; and a clinical rating has changed. The results elucidate on two levels of frame-rate requirements: recommended and minimal. Using the established relationships, clinicians should be able to customize HSV instrumentation based on the specific requirements of their clinical protocol.

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**To What Degree of Voice Perturbation Are Jitter Measurements Valid?**  
*A novel approach with synthesized vowels and visuo-perceptual pattern recognition*

Objective measurement of the severity of dysphonia typically requires signal processing algorithms applied to acoustic recordings. Since Lieberman (1963) introduced the concept of perturbation analysis in the area of voice, the most dominant acoustic parameter in clinical practice is the classical *jitter*. However jitter measurements have some critical limitations. According to a widely accepted guideline, in sustained vowels of dysphonic voices, only perturbation measures less than about 5% are reliable: this is related to period extraction methods. This limit of 5% deserves critical analysis, certainly when there are indications that some acoustic analysis programs can be applied to quite irregular voices as substitution voices. The present experiment demonstrates that – on signals of synthesized deviant voices (sustained vowel) with moderate additive noise - different raters are able to visually identify in a very consistent way the period durations of successive cycles up to values of at least about 13% jitter. This suggests that improved acoustic programs using more robust algorithms could validly transgress the traditional limit of 5% if they demonstrate the correspondence of their computations with the true jitter values. This is now made possible by synthesizers generating artificial deviant voices that cannot be recognized from true dysphonia, and in which the jitter put in is exactly known.

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## Spectrum Energy and Sound Pressure Level

When the voice spectrum energy spreads to higher frequencies, the spectral and temporal detail of the voice signal is enhanced. Practically all voice parameters are influenced in one way or another by this boosting effect. A change in sound level is the primary factor to bring about such a spectrum change. The link between the spectrum slope and sound pressure level (SPL) was studied for instance by Sundberg & Nordenberg (2004, 2006), and by Ternström, Bohman & Södersten (2006). Their findings concern different aspects of the SPL-spectral slope relationship, which is not always linear; also, the magnitude and even the direction of the SPL dependency are not uniform over the entire frequency range.

Using a voice range profile (VRP) based averaging system, which sorts spectra into bins by  $F_0$  and SPL, the spectrum dependency on  $F_0$  and SPL was isolated. Next, a principal components analysis (PCA) was performed. This revealed two distinct frequency regions with different dependencies on SPL: a low- and a high-frequency regime that separate at about 1 kHz. The generality of this finding was addressed by comparing the PCA results for individual voices as well as for groups of trained and untrained, male and female voices. Separate slope measures for the two frequency regions were defined and mapped over the VRP. The resulting patterns are discussed and compared to those of other recorded voice quality measures. Models that could explain the mechanisms involved are proposed.

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**Effects of Vocal Warm-up, Vocal Loading, and Tube Phonation on Phonation and Collision Threshold Pressures**

Collision threshold pressure (CTP) is defined as the lowest subglottal pressure producing vocal fold collision. It has been measured in three studies, to analyze the effects of (1) vocal warm-up, (2) vocal loading and (3) the voice therapy method resonance tube phonation, which implies phonation into a tube, the end of which is placed a few cm under water. Also, phonation threshold pressure (PTP) was determined. This threshold pressure, however, although more commonly used, is often difficult to measure; the coefficient of variation has been found mostly to be higher for PTP than for CTP.

Before and after data for CTP and PTP were determined from audio, electroglottographic (EGG) and pressure signals. Subjects repeated the syllable /pa:/ with gradually decreasing vocal loudness at several fundamental frequencies. Subglottal pressure was estimated from oral pressure during the p-occlusion. CTP was determined using EGG or dEGG spike amplitude as criteria of vocal fold collision, while vocal fold vibration for PTP measurement was determined from the audio signal.

The first investigation, with 15 amateur singers, suggested that vocal warm-up tended to lower both CTP and PTP. The effect of vocal loading, studied in seven subjects two of whom had trained voices, was that CTP and PTP rose, especially in the untrained voices. Resonance tube phonation exercise (tube length 27 cm,  $\varnothing$  8 mm) caused an increase of CTP and PTP in 12 mezzo-soprano voices, with different levels of voice training. The effect on both CTP and PTP was greater in less trained singers, and was perceived as an improvement in a pair-wise comparison listening test with seven voice experts.

The three studies support the conclusion that CTP can be used as a valuable complement to or replacement of PTP.

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### **Aerodynamic and Acoustic Effects Associated with Supraglottic Activities**

*Purpose:* The purpose of this study was to quantify the aerodynamic and acoustic effects due to medial and anterior-posterior compression of the false vocal folds (FVF), which may be seen in some dysphonic patients. These effects include variations in the laryngeal glottal flow resistance, fundamental frequency, and the sound intensity.

*Method:* Canine and human larynges were prepared and mounted over an excised larynx bench and vocal fold oscillations were generated and controlled by the flow of air through the glottis. Glottal adduction was accomplished by rotating the arytenoids with a suture passed behind the vocal folds to simulate lateral cricoarytenoid muscle action. Medial and anterior-posterior compression of the FVF was accomplished by manual squeezing at the arytenoid level and alternating between the rest and compressed conditions. The raw data, including EGG, subglottal pressure, flowrate, and microphone signals, were recorded on a DAT tape and later digitized and processed with Matlab. A video image of the superior aspect of the larynx was recorded using a stroboscopic light during the whole experiment and with high-speed video imaging for selected cases.

*Results:* Results indicated that the excised larynges oscillated better and easier without the false vocal folds, but generated louder sound with false vocal folds. Medial compression always resulted in increased subglottal pressure and decreased flowrate (increased glottal resistance) and most often increased the sound intensity, but decreased EGG closed quotient. Both of these compressions had negative effects on the amplitude of EGG signal, suggesting disruption of vocal fold contact. This work was supported by NIDCD grant # DC009567.

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## The Electroglottographic Spectrum as an Indicator of Phonatory Activity

Although the electroglottographic (EGG) signal is not acoustic, one might expect that some of the source-induced variation in the spectrum slope of the airborne signal would be present also in the EGG signal. Wideband spectra of EGG signals were evaluated from sustained and intermittent phonation under various conditions, including changes of electrode position, vowel, subglottal pressure and SPL. Recordings were made of subjects producing /pV/ utterances with simultaneous acquisition of EGG and intraoral pressure. The EGG spectrum envelope was found to be quite linear in dB/octave, with the exception of the fundamental partial. The EGG spectrum effects of vowel changes were negligible. EGG spectrum slope change with SPL was large at phonation onset and small in loud phonation. Additionally, recordings from an existing database of 8 trained male singers were analysed for EGG spectrum variation with SPL. The singers performed crescendo tasks on sustained tones, with a typical SPL variation of up to 20 dB from soft to loud. The corresponding EGG spectra had slopes of -14 to -9 dB/octave. The variation in EGG spectrum slope was again small, on the order of one quarter of the slope variation in the airborne spectrum. Occasionally, ripple in the EGG spectrum envelope was present, due to double peaks in the time derivative of the closing part of the EGG waveform. We conclude that the EGG spectrum slope appears to offer a convenient contacting criterion, but will be harder to use for judging vocal effort beyond contacting.

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## **Whisper and Phonation: Aerodynamic Comparisons across Adduction and Loudness Levels**

The purpose of the present project was to study the aerodynamic flow, subglottal pressure, and laryngeal flow resistance for both whisper and phonation across loudness and glottal adduction levels.

Three males and five females between 20 and 40 years of age whispered and phonated the nine production conditions, breathy, normal, and pressed for adduction, and soft, medium, and loud for loudness. Smooth syllable strings of repeated /baep:/ were produced and the middle three syllables were used. The Glottal Enterprises system was used.

A regression analysis was performed using a Proc-mixed procedure with SAS statistical software.

For subglottal pressure, no statistically significant differences were found between whisper and phonation.

For airflow, significant differences were found between whisper (greater airflow) and phonation (less airflow):

For females, for:

- all 3 glottal adduction levels in the medium and loud conditions, and
- the normal adduction-soft condition.

For males, for:

- soft - normal adduction,
- medium loudness - pressed and normal adductions, and
- loud - pressed and normal adductions.

For flow resistance, significant differences were found between whisper (less) and phonation (more):

For females, only for:

- pressed and normal adductions in the medium and loud conditions

For males, only for::

- the normal adduction and loud condition.

For airflow, subglottal pressure, and flow resistance, more variation was accounted for within subjects than between subjects.

Implications of these findings for clinical management and whispered speech synthesis will be discussed.

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## **Rat Ultrasonic Vocalizations: A Behavioral Model for Studying Laryngeal Neurobiology**

### Introduction

Behavioral voice therapy is a critical component in the treatment of voice disorders. While many animal models have been used to advance our understanding of medical and surgical laryngeal interventions, no model exists to investigate the link between changes in vocal behavior and underlying laryngeal neurobiology.

The ultrasonic vocalizations (USVs) of rats have much in common with human vocalizations; they share central and peripheral neural pathways, are produced in the larynx by air flowing through a constricted glottis, and are modulated by rapid adjustments of the intrinsic laryngeal musculature. Therefore, training rats to increase and/or modulate their USVs can be used as a model to study the connection between vocal behavior and laryngeal neurobiology.

### Methods

Both young and old rats were either vocally exercised or given no intervention over 8 weeks. USVs were compared between age and intervention groups both pre- and post-intervention. Changes in laryngeal neurobiology were assessed by measuring neuromuscular junction (NMJ) morphology in the thyroarytenoid muscle as well as the localization of agrin, a necessary component of motor endplate aggregation.

### Results

Age differences were found in measurements of both USV acoustics and NMJ morphology. Vocal training reduced or eliminated some of these differences. Significant correlations between measurements of USV acoustics and NMJ morphology were found, particularly between measures of vocalization intensity and NMJ stability.

### Discussion

This study is the first to examine how training rats to increase their USV production changes their vocal behavior, and how those changes correlate with underlying neuromuscular adaptations.

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## Acoustic Characteristics of Irrintzi

### Introduction

The aim of this work is to analyze and characterize acoustically an expression of the basquenavarrian folklore called irrintzi. An irrintzi is a howling scream, mixing sound between yell and loud laugh, let out by the people who live in the mountains. Is similar to galician Aturuxu. Basque-Spanish-French Dictionary defines it in this way: shrill yell very loud and lengthy that shepherds make resound in the sides of the mountains, and that the basque people throw/launch-shout as a signal of joy.

### Subjects

There has been studied emission of 5 women of between 50 and 70 years. The number of samples by every irrintzilari was 3.

### Methods

The study protocol includes: Nasofibroendoscopy: laryngeal and pharyngeal mobility during the emission, video recording of position and mandibular movements, analysis of the maximum intensity, recording of acoustic and electroglotographic signals, transglottal flow and intraoral-subglottal pressure and lateral pharyngolaryngeal radiological study of the mobility of larynx and vocal tract . Acoustic analysis included various parameters (F0, intensity variations, and spectrographic characteristics, harmonics and formants)

### Results

Due to variations seen in Spectrographic plot the sample can be divided in three well characterized parts with specific acoustic characteristics explained by different physiological mechanisms.

### Discussion

The results shown that the irrintzi is a very special and unique vocal sound with a specific physiologic characteristics of production, in same aspects similar to other folkloric expressions but with a important cultural meaning as a folkloric expression of the Navarra and Basque region of Spain.

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## Voice Identification –Acoustic and Perceptual Analysis in Monozygotic Twins

It has been described in the literatures that the monozygotic twins' voices are auditorily similar. The present study was designed to identify the parameters of voice which are similar in monozygotic twins both perceptually and acoustically. The main purpose of the study is to determine the vocal characteristics among eight pairs of monozygotic twins-3 females and 5 males between the age ranges of 10-15 years. Perceptual evaluation results reveal that the voices between the twin pairs could not be distinguished as different. Acoustical analysis were carried out to see whether there was any resemblance in acoustical aspects of their voice .Statistical analysis was carried out to find out the acoustic parameters that were significantly different between the monozygotic twins. The results of acoustical analysis will be discussed in the light of available literature and it can throw light in voice identification and forensic science.

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### **Human Infant Cries and the Roars of Lions and Tigers: How Similar Are They?**

We compare two vocalizations that would appear to have nothing in common, the loud cry of a human infant and the roar of a lion or tiger. The basic difference is fundamental frequency, to the extent that it exists. Infants cry around 500 Hz whereas lions and tigers roar around 30 Hz. The similarities are striking. Both vocalizations are aperiodic (rough, noisy) and loud for the laryngeal architecture. Infant vocal folds have a length of around 3 mm while big cat vocal folds are around 3 cm. This explains the frequency difference. Vocal fold tissue layers are low in elasticity and not dominated by uni-axial fibers. Hence, the vocalizations are not tonal (or melodic), but deliberately noise-like and grating to draw attention. In one case the clear message is “Come quickly, I need your help,” whereas in the other case it is “Leave now, you are in my territory.” Computer simulation will be used to transform the cry into a roar and the roar into a cry.

Note: I would like a minimum of 20 minutes for this oral podium presentation, if possible.

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## Frequency of Amplitude Modulation and the Perception of Roughness in Vowels

Recent work (Eddins, Shrivastav & Singh, 2010) has shown that amplitude modulation (AM) of the vowel waveform contributes to perceived roughness. Two different aspects of AM – the frequency of modulation and the depth of modulation – may impact roughness. In the current experiment, the effects of AM frequency at constant modulation depth were evaluated for a set of synthetic voices. Based on prior research with sinusoidal carriers (Zwicker and Fastl, 1999), it is hypothesized that some modulation frequencies contribute more to perceived roughness than others.

*Hypothesis:* The relationship between amplitude modulation frequency and roughness will be non-monotonic and be best represented by a band pass filter function.

*Methods:* Four voice stimuli (vowel /a/) were chosen from the Sataloff /Heman-Ackah voice database, representing a range from minimal to severe roughness. These were then replicated using a Klatt synthesizer to obtain stimuli with identical fundamental frequency and formants, but with no AM. Each stimulus was convolved with a cosine wave at differing *fAM* rates (10, 15, 20, 30, 40, 50, 70, 90 Hz) to result in an amplitude modulated vowel waveform with a constant modulation depth of 50%. Ten listeners were asked to judge the roughness of these stimuli using a single-variable matching task as described by Patel et al (2010).

*Results/Conclusions:* Preliminary results (from five participants) indicate that maximum roughness is achieved for *fAM* between 30-40 Hz. The modulation transfer function for roughness appears to be a band-pass filter function.

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### **Vocal Symptoms, Vocal Care and Vocal Habits of Radio Announcers from Macapá, Brazil**

The radio announcers need to provide great versatility in their career as a communicator. The use of voice without the specific preparation can overwhelm the vocal tract and generate vocal disabled adaptations. The study included 16 radio announcers, whose work in AM and FM radio station. A self-administered closed questionnaire, with 28 questions, was applied. The questionnaire had three dimensions: personal, work and symptoms. It was found that 100% were male, 62.5% had preparatory training for speech broadcaster, 75% work five hours a day; only 31.25% usually drink water at natural temperature. About the habits of voice care: keeping upright and feet on the floor during the speech (87.5%), doing vocal training before the locution (68.75%) and use monitoring voice during speech (50%). Voice habits detrimental reveal that 87.5% work in air-conditioned environment, 56.25% drink coffee during work, 81.25% always speak with high intensity, 43.75% drink alcohol. It was observed that 50% is smoker. The vocal symptoms presented by the radio announcers were: hawks (50%), hoarseness (43.75%), cough (43.75%), thick saliva (37.5%), sore throat (31.25%) and voice failures (25%). Most of the individuals presented only three habits of voice care: erect and feet flat on the floor during the speech, heating and vocal monitoring. The commonly harmful voice habits were: uses of air conditioning at work, drinking coffee during the speech, speak in high intensity, alcohol intake, use of sprays and lozenges, and tobacco. Time of service and daily work hours are related significantly to the presence of vocal problems.

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## Comparisons of Voice Onset Time for Female Singers and Nonsingers During a Speech Task

*Objectives:* The purpose of this study was to examine the temporal differences in VOT between elderly singers and nonsingers during a speech task.

*Methods:* Thirty female participants were separated into two groups of 15 according to level of participation in singing (ie, singer or nonsinger). The participants spoke a carrier phrase containing English voiceless bilabial stops. Voice onset time (VOT) was measured for the stop consonant productions.

*Results:* The results of this study indicated that there was a statistically significant difference between VOT for singers and nonsingers with VOT being longer for singers than nonsingers.

*Conclusions:* The results suggest that acoustic features of the aging voice appear to be associated with participation in amateur singing and that VOT may be a useful parameter when measuring the aging voice.

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### **Reliability of WaveSurfer, Praat, and the Computerized Speech Lab**

WaveSurfer, Praat, and the Computerized Speech Lab analyze the acoustic properties of speech and voice. WaveSurfer and Praat are free software programs downloaded from the internet. The Computerized Speech Lab is offered at a cost to the consumer through KayPentax (Montvale, NJ). To date, no study has assessed the reliability of all three programs. The current study analyzed properties of speech and voice for both a female and male participant of the same age with no diagnosed speech or voice disorders. To assess the reliability of the various speech and voice analyses across the three programs, a reliability coefficient ( $r_{xx}$ ) was used. The following will be discussed in the poster presentation: rationale for conducting the studies with experimental questions, methodology, results, and explanation of findings.

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## Evaluation of Auditory and Visual Feedback for Airflow Interruption

*Introduction:* Clinical application of mechanical interruption methods for measuring aerodynamic parameters has been hindered by high intrasubject variability. To improve intrasubject reliability, we evaluated the effect of auditory and visual feedback on subject performance when measuring aerodynamic parameters with the airflow interrupter.

*Methods:* Eleven subjects performed four sets of ten trials with the airflow interrupter: no feedback (control); auditory feedback (tone matching subject's  $F_0$  played over headphones); visual feedback (real-time feedback of amplitude, frequency, and airflow); and combined auditory and visual feedback. Task order was varied across subjects. The mean and coefficient of variation (CV) of subglottal pressure ( $P_s$ ), mean flow rate (MFR), and laryngeal resistance ( $R_L$ ;  $P_s$ /MFR) were calculated and compared between pairs of tasks using paired t-tests.

*Results:* Each feedback method significantly decreased the CV of  $R_L$  compared to control trials (auditory:  $p=0.005$ ; visual:  $p=0.008$ ; combined:  $p<0.001$ ). Auditory ( $p=0.011$ ) and combined feedback ( $p=0.026$ ) also decreased the CV of MFR. There was no significant difference for any parameter when comparing different feedback methods against each other. Using visual feedback alone led to increased mean MFR values compared to controls ( $p=0.054$ ) and auditory feedback ( $p=0.048$ ). Mean  $P_s$  was higher when using auditory feedback compared to visual feedback ( $p=0.001$ ).

*Conclusions:* Each feedback method improved intrasubject consistency when measuring  $R_L$ . Feedback appeared to have a greater effect on MFR than  $P_s$ . While there is no clear optimal feedback method, each is preferable to not providing any feedback during trials. Evaluating new methods of visual feedback to further improve MFR and thus  $R_L$  measurement would be valuable.

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## High Speed Digital Imaging Coupled With Laser Projection Imaging for Measurement of Pediatric Voice

*Introduction:* Nationwide over 6-9% of all children suffer from dysphonia that can be detrimental both psychologically and academically, hence early identification and restoration of optimal vocal health is critical. Objective assessments of pediatric vocal physiology are non-existent, leading to delayed diagnosis and deferred treatments.

*Objective:* The aim of this study is to present the development and calibration of miniature laser projection systems to quantify vocal fold length and vibratory amplitude of the pediatric glottis using high speed digital imaging. In this study we will present results of two different types of laser systems: two-point laser endoscope and structured light laser endoscope.

*Methods/Preliminary Results:* For this prospective study, absolute measurement of entire vocal fold length, membranous length of the vocal fold, and vibratory amplitude during phonation will be presented from 5 pre-pubertal children (5-11years) and 10 adults (5 males, 5 females, 21-45years) without voice disorders.

Measurement of vocal fold length in one child (9 year old), one adult male (36 year old), and one adult female (20 year old) with the two-point laser revealed the phonatory vocal fold length of 6.8 mm  $\pm$  0.0002 in the child, 17.62 mm  $\pm$  0.003 in adult male, and 12.69 mm  $\pm$  0.002 in adult female. Mid membranous vibratory amplitude of 0.29 mm  $\pm$  0.06 in the child, 0.88 mm  $\pm$  0.03 in adult male, and 0.80 mm  $\pm$  0.04 in adult female during phonation at self-selected typical pitch and loudness production of the vowel /i/. Findings comparing results from two-point laser endoscope and structured light laser endoscope will be presented.

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### **3D Biomechanical Properties of Human Vocal Folds via Application of a 3D Multi-Mass Model to Experimental Hemilarynx Dynamics**

*Introduction:* The traditional laryngeal endoscopy allows for the two-dimensional visualization of the vocal-fold movements in the lateral and longitudinal dimensions. A major limitation of endoscopy is the inability of capturing the vertical dimension of vocal-fold motion. Our previous studies developed and validated a biomechanical three-dimensional (3D) multi-mass model with an optimization procedure.

*Method:* To characterize the 3D biomechanical properties of the vocal folds, the previously modeling technique was adapted to 24 hemilarynx datasets. The 3D distributions of local effective mass and stiffness of the vocal-fold were computed. Their variations were statistically analyzed as a function of glottal airflow, posterior glottal adduction, and vocal-fold elongation.

*Results:* The average value of the relative error between the 3D model and the experimental dynamics was 13%, and the correlation between their trajectories was 83%. Along the longitudinal direction: the mass increased, the lateral and longitudinal stiffness decreased, and the vertical stiffness slightly decreased from the anterior towards the middle, and subsequently increased towards the posterior of the vocal folds. Additionally, stiffness increased and mass decreased with increased airflow, and tension increased with increased elongation.

*Conclusion:* The current approach represents a significant methodological advance towards quantifying the 3D biomechanical properties of the vocal folds during phonation; given that direct and reliable measurement of the vocal-fold tissue properties in an intact human larynx is extremely challenging, yet often impossible. Further optimization of the 3D model using additional cues on human laryngeal dynamics could enable the investigation of the vocal-fold tissue properties over relevant neurophysiological phonatory conditions.

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## **Sensitivity Analysis of Lumped Mass Models in Phonation**

Steineke & Herzel (S&H) model is a lumped mass model widely used to simulate phonation. This model produces an area time history. Various phonation descriptors such as Open Quotient (OQ), Speed Quotient (SQ), Signal Frequency (F) and Flow (U) were calculated from this area time history. S&H model has 15 parameters. A clear understanding of the parameter bounds and the relative importance of the components of the S&H model was lacking. The goal of this study was to determine the sensitivity of various model parameters of the lumped mass models. Multiple approaches were used to address sensitivity due to the lack of a fail proof method. Initially, the bounds of the parameters were estimated using the One-at-a-Time Variation (OAT) method. Then screening methods were applied to provide a ranking of the S&H model parameters based on the influence of the parameter on the overall response from the model. These methods are essentially first-order estimates of parameter importance. One-at-a-Time Variation (OAT) and Cotter's method were the two methods used in this study. These methods occasionally fail to identify key parameters, and cannot precisely quantify the contribution of each parameter. The results of the screening methods were checked using a Monte Carlo sensitivity analysis with over 400K sensitivity values. Monte Carlo sensitivity analysis provides very detailed information about the sensitivities of the model.

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## Presbylarynx – Acoustic Analysis in Indian Population

Presbylarynx refers to age related structural changes of vocal folds. Changes related to age vary a great deal from person to person, both in severity and time of onset. Some individuals may retain a resonant, normal-sounding voice deep into their 80s, whereas others begin to sound “old” as early as their 50s. Like any other part of the body, larynx also changes as we grow older. Many of these alterations are unnoticeable; however some changes with age can affect the quality and sound of the voice.

Our study focuses on the changing parameters of voice in elderly. The acoustic parameters of males and females with normal voice between the age groups of 60 to 90 were studied. 30 subjects in each category (male and female) were included in the study. All the subjects were taken after clearance from ENT to rule out any vocal pathology. The parameters taken were formants (f1, f2), pitch, jitter and shimmer. These parameters were found to be changing across the age groups. This study can provide a light on the change in the voice parameters in elderly population in Indian scenario.

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### Using iPhone for Acoustic Recording in Speech and Voice Analysis

This study evaluates the suitability of using a multimedia-enabled mobile phone, such as the iPhone model which is equipped with a high sampling rate (48,000 Hz), to record voice signals for extracting acoustic measures to detect voice changes due to common voice pathology and clinical treatment. Participants, including 10 normal speakers and 10 voice patients, aged between 27 to 79 years, were asked to read the “Rainbow passage” for microphone recording. Acoustic measures included fundamental frequency, perturbation measures, amplitude difference between the first and second harmonics, singing power ratio, frequencies of the first and second formants, spectral tilt, and speech moment analysis measures. Based on the acoustic signals simultaneously recorded from the normal speakers through an iPhone (Model A1303) and another high-quality direct digitization system (National Instrument DAQCard-AI-16E-4), the correlation between measures obtained from the two systems were found to be high. Results from a series of acoustic comparisons between the pre- and post-operative iPhone recordings obtained from the voice patients consistently demonstrated a positive post-treatment voice change, which was confirmed with subjective auditory assessment. In addition to the change in vowel space and perturbation measures, the amplitude difference between the first two harmonics, a measure related to breathiness, was found to reflect voice changes in patients with vocal paralysis. This study provided evidence not only demonstrating the adequacy of using an iPhone to record voice for a selection of voice assessment measures but also confirming the need to avoid comparing voice quality measures obtained from different digital recording systems.

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**Effect of Subglottal Pressure Variation on the “Closed Quotient”  
Comparing Data Derived from Electroglottograms and from Flow Glottograms**

Closed quotient ( $Q_{\text{closed}}$ ), derived from flow glottograms and contact quotient ( $Q_{\text{contact}}$ ), derived from electroglottograms, are sometimes regarded as identical measures. Previous studies report differing results regarding how these parameters vary with vocal loudness (Sapienza & al., 1998). Moreover, differing definitions of  $Q_{\text{closed}}$  are commonly used (Herbst & Ternström, 2006). The present investigation aims to clarify how  $Q_{\text{contact}}$  and  $Q_{\text{contact}}$  (i) varies with subglottal pressure and (ii) is affected by phonatory parameters. Audio, electrolaryngograph, oral pressure and air flow were simultaneously recorded for five male singers, who were asked to repeat the syllable [pae] in diminuendos from loud to soft at various pitches.  $Q_{\text{closed}}$  was extracted by inverse filtering, whereas  $Q_{\text{contact}}$  was measured from electrolaryngography, using the Decap and SpeechStudio softwares, respectively. Subglottal pressure was measured in terms of the oral pressure during /p/ occlusion. Different phonatory parameters were determined (i.e.  $F_0$ , normalized amplitude quotient and the dominance of the voice source fundamental). Their correlations with the  $Q_{\text{contact}} / Q_{\text{contact}}$  ratio were analyzed.  $Q_{\text{contact}}$  and  $Q_{\text{closed}}$  showed a positive correlation with each other, even though  $Q_{\text{contact}}$  was mostly higher than  $Q_{\text{closed}}$ . A systematic variation with subglottal pressure was observed for both, but the variation was greater for  $Q_{\text{closed}}$ . Possible reasons for these differences will be discussed.

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## Comparative Analysis of Porcine Vocal Folds From Two Age Groups

Porcine vocal folds have similar histologic properties to human vocal folds; fundamental frequencies of excised porcine vocal folds were around 200 Hz, a comparable frequency to human female and child phonation. Age comparison of porcine vocal folds has never been studied. The purpose of the current study is to evaluate pediatric (4-5 months) porcine vocal fold tissues and compare them to slaughter-age tissues (8-10 months). We also compared results to human vocal fold data found in the literature. *Methods:* Presence of tropoelastin, elastin, and collagen III in the mid-membranous region was quantified by treating samples with horseradish peroxidase immunohistochemical staining and intensity was evaluated using ImageJ. Transmission Electron Microscopy was used to quantify several components of the fibroblast ultra structure.

*Results:* Protein densities of elastin, tropoelastin, and collagen III in the inferior VFs of young and slaughter age pigs were not different ( $p > 0.05$ ). Elastin and collagen III densities, however, were lower in the young superior VF (SVF) than the slaughter SVF. Tropoelastin in the young SVF was significantly higher than in the slaughter SVF. Additionally, tropoelastin was more and collagen III was less in the slaughter inferior VF as compared to the slaughter SVF ( $p < 0.05$ ). TEM analysis is under way. Preliminary TEM images indicate differences between cell shape and number of fibroblasts found in the maculae flavae when compared with the mid-membranous porcine vocal fold. This is similar to the findings of Hirano et al (1999) in human vocal fold tissue. Further results will be forthcoming.

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## Investigating Potential Gender Differences in the Central Neural Organization of Vocalization

Brain imaging studies have shown variable regional and spatial gender-related differences in the central neural organization for various cognitive and sensorimotor behaviors. However, questions remain whether similar differences exist in the brain for vocalization. The purpose of this study was to characterize regional differences in brain activity during vocalization tasks between males and females. A retrospective analysis of previously collected functional magnetic resonance imaging (fMRI) data was conducted. In the source data set, 24 healthy adults (9 males, 15 females; ages 21-57) performed three vocalization tasks (reading sentences covertly, whispered and overtly), during event-related sparse sampling fMRI. In the current analysis, ANOVA was used to identify activation differences in select regions of interest (ROI) including periaqueductal gray (PAG), anterior cingulate gyrus (ACG), cerebellum, pre- and post-central gyri, pre-frontal cortex, and BA 40. Independent variables included the three reading conditions, ROI lateralization and gender. Averaged percent change of BOLD activity served as our dependent measure. Functional data were analyzed using AFNI. Based on the auditory processing and visuo-motor transferring literature, we expected to reveal regional, and hemispheric BOLD differences in pre-frontal, pre-motor and primary sensorimotor cortices. Differences may also exist in PAG, cerebellum, BA 40 and ACG as a function of gender. Preliminary data indicate possible gender differences in ACG, with stronger male activation in ACG, but not in PAG. Our ongoing study will be the first to identify gender differences in the central organization of vocalization. Our data will be useful for informing current voice production theories.

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## Longitudinal Voice Variability in a Teacher-Singer with Cushing's Syndrome

Cushing's Syndrome occurs when adrenal glands produce excessive androgenic hormones, corticosteroids and/or aldosterone. Symptoms include voice variability and dysphonia, i.e. hoarseness, breathiness, reduction in power, brightness and duration. Acoustic and videostroboscopic voice measures of a music teacher/singer with Cushing's were examined for four months, with results showing cyclic voice variability. This 54-year old Chicago-area music teacher/singer was found to have cyclic speaking and singing voice variability in October 2009 through February 2010. This patient also had a past history of asthma, GERD, and the following Cushing's Syndrome symptoms: upper body obesity, round face, high blood pressure, high blood sugar and cholesterol levels, bruising, and bone and muscle weakness and vocal variability beginning in her early 20's. She previously had an adrenal tumor removed in November 2008 after a differential diagnosis of Cushing's Syndrome.

Since Cushing's Syndrome symptoms often continue after an adrenal tumor is removed, patients can continue to have symptoms, including vocal variability for his/her lifetime. Acoustic and videostroboscopic measurements of this patient's voice during four equally spaced appointments showed two within normal limits alternating with two with marked vocal fold micro-varices with concurrent dysphonia symptoms. A single-subject Longitudinal Alternating Treatments Design across conditions was implemented. A four-week Therapeutic adaptation phase (Wicklund 2010 and Wicklund and Vogley 2004) for her singing and speaking voice were made using Resonant Voice Therapy (Verdolini 2004) and Wicklund (2010) singing habilitation exercises. Medical management included prescription steroids, reflux medications and varices monitoring/removal. Methods and Results will be discussed in this Powerpoint presentation.

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### Frame by Frame Analysis of Glottic Closure in Fasting Subjects

**Objective:** The purpose of the study is to examine the vocal fold closure in fasting subjects using Frame by Frame analysis

**Material and Method:** A total of twenty two male subjects have been recruited for this study. Demographic data included age, weight and history of smoking. All subjects were evaluated while fasting and non-fasting. Frame by frame analysis of at least three glottic cycles using laryngeal video-endostroboscopy was performed. The degree of phonatory effort and vocal fatigue was reported.

**Results:** There was a significant increase in the phonatory effort while fasting compared to non-fasting (0.23 non-fasting vs. 0.77 fasting, p value 0.036). There was a non significant increase in the overall mean of vocal fatigue by 0.32 (p value 0.07). This was accompanied by a significant decrease in weight (p value of 0.00)

For the Frame By Frame Analysis, the mean closed quotient for all subjects while non fasting was  $0.427 \pm 0.098$  and while fasting  $0.441 \pm 0.073$ , with no significant difference between the two (p value 0.417). Thirteen out of the twenty two subjects had no change in their mean closed quotient while fasting.

**Conclusion:** Fasting subjects have increased vocal effort and fatigue accompanied by weight loss in the majority of the cases. Frame by Frame analysis failed to reveal any changes in the closing phase of the glottic cycle to indicate either glottic insufficiency and or hypo or hyperkinetic behavior.

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### Vocal Changes in Patients with Prostatic Cancer Following Androgen Ablation

**Objective:** to compare the prevalence of vocal symptoms and parameters in patients with prostatic cancer treated with androgen deprivation therapy (ADT).

**Material and Method:** Thirty two male patients between the age of 60 years and 83 years were recruited for this study. The subjects were divided into two groups: One group consisted of 18 patients with prostatic cancer treated with ADT using GnRH agonist and a second group consisting of 14 controls matched according to age. Demographic data included age, history of smoking, reflux and duration of therapy. The reported phonatory symptoms were hoarseness, inability to project the voice and vocal fatigue. Patients also underwent acoustic analysis and the following acoustic variables were measured: Fundamental frequency, relative average perturbation, shimmer, noise to harmonic ratio, voice turbulence Index.

**Results:** Compared to the control group there was no statistical difference in any of the phonatory symptoms. The habitual pitch was significantly higher in the prostate group compared to the controls (131.76 Hz vs. 114.11Hz) with a p value of 0.021. There was also a significant increase in all the perturbation parameters, namely Relative Average perturbation and Shimmer with a significant difference with respect to this later (p value 0.014). There was also a significant increase in the noise to harmonic ratio (p value 0.014).

**Conclusion:** The administration of ADT for patients with prostatic cancer can affect the habitual pitch. However there are no noticeable vocal changes reported by the patient.

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**Can Oropharyngeal pH Measurement (ResTech Dx-pH) and the Reflux Symptom Index (RSI) Identify Individuals with Laryngo Pharyngeal Reflux (LPR)?**

**Introduction:** Currently, there is no gold standard investigation of LPR. The approach to the diagnosis varies between the otolaryngologists and gastroenterologists. A therapeutic trial of high dose proton pump inhibitor based on symptoms and laryngeal findings is commonly undertaken by otolaryngologists. Alternatively, patients may be referred for ambulatory pH measurement. ResTech is a novel technique of measurement of oropharyngeal pH which we hypothesised may be used as an adjuvant to the Reflux Symptom Index (RSI) questionnaire to identify LPR.

**Methods:** Consecutive patients with at least one extra-oesophageal symptom and who had undergone laryngoscopy to rule out serious pathology underwent assessment by RSI, standard ambulatory distal pH measurement and ResTech whilst off acid-suppression. A total RSI score of >20 (maximum 45) was considered abnormal, pathological gastro-oesophageal reflux disease was defined by distal pH<4 for >4.2%. A positive ResTech result is defined by either upright pH<5.5 for >0.13% or supine pH<5.0 for >5.15%.

**Results:** A total of 69 patients were studied. Patients were stratified according to the RSI score: 37 (54%) patients had RSI >20 of whom 16 (43%) did not have excessive measured distal pH. Of these 5 (31%) had positive ResTech. 21/37 (57%) high RSI-score patients did have excessive distal pH, and 5 (24%) had positive for ResTech.

Fifteen (47%) out of 32 patients with RSI ≤20 had excessive distal pH, of whom 6 (40%) had a positive ResTech. A similar proportion, 35%, of the 17 patients with normal distal pH were ResTech positive.

**Conclusion:** The combination of RSI score and ResTech measurement of oropharyngeal pH does not help identify LPR patients, whether in those with or without measurable excess distal oesophageal acidity.

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**Temporal Correlation Between Apnea and Reflux Episodes in Patients with LPR and OSA**

Introduction: There has been a number of studies suggesting an association between Gastroesophageal Reflux Disease and its Laryngopharyngeal manifestations (LPR) and Obstructive Sleep Apnea (OSA). However, it is unclear if it is the inflammatory and vagal reflex responses at the laryngopharyngeal segment that trigger apneic episodes, or if it is the apnea itself that decreases lower esophageal sphincter tone and facilitates reflux. Objective: To try to establish a temporal correlation between apnea and reflux episodes in patients with LPR and OSA. Material and Methods: Twelve consecutive adults with LPR and OSA underwent prolonged esophageal pH-impedance testing during polysomnographic study. Commercially available software was used to synchronize reflux and apnea episodes. The correlation between awakenings and reflux was also established. Results: The mean age of the studied population was 45.8 years; 5 patients were females and 7 were males. The mean body mass index of females was 28.7 (SD±0.87) and of the males it was 29.2 (SD±0.98). The mean apnea/hypopnea index was 24.3/hour. Seven of the 12 patients presented acid reflux and one had non-acid reflux episodes. Although the reflux episodes seemed to occur mostly following the apnea or awakening episodes, no temporal correlation could be established. Conclusions: Both LPR and OSA are highly prevalent diseases, which makes it hard to establish their association is a coincidence or if one disease may be triggered by the other. Literature suggests a bidirectional relationship; however in this pilot study no temporal correlation could be established.

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## Immediate Changes in Voluntary Cough Airflow Post Office Based Vocal Fold Medialization Injections

This study examined immediate change in voluntary cough airflow following in-office injection of Radiesse™ for the treatment of glottic closure insufficiency in three individual cases of patients diagnosed with glottic insufficiency acquired from diverse etiologic factors. Degree of glottic insufficiency was judged by an otolaryngologist using laryngeal endoscopy with videostroboscopy. Due to the significant comorbidities presented by these patients they were deemed as poor candidates for medialization thyroplasty or injection augmentation under general anesthesia. Therefore, they were treated using Radiesse™. Each patient perceptually presented with clinical symptoms of moderate to severe dysphonia characterized by decreased vocal loudness and vocal endurance. Ineffective voluntary cough resulting in poor clearing of secretions and ingested fluids from the airway was clinically perceived and subsequently documented. Dysphagia, including poor secretion management, pooling of secretions in the oropharynx and delay in onset of the pharyngeal swallow, confirmed by either modified barium swallow study and /or fiberoptic endoscopic examination of swallowing was documented clinically for all three patients. Primary outcome measures were extracted from the cough airflow signal. Measures of voluntary cough airflow were obtained approximately 30 minutes before and after the Radiesse™ injections. Airflow produced during the voluntary cough production was sampled using an oral pneumotachograph (MLT 1000, ADInstruments, Inc) connected to a spirometer (ML141, ADInstruments, Inc.). Injection of Radiesse™ improved cough effectiveness through changes in specific cough airflow parameters. Improvements in cough gained following injection of Radiesse™ may be further enhanced by expiratory muscle strength training (EMST) following injection.

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## Superior Laryngeal Nerve Paralysis, the Hidden Diagnosis of an Overlooked Entity

### Introduction:

The external branch of the superior laryngeal nerve (ESLN) innervates the cricothyroid muscle of the larynx, a vocal fold tensor primarily responsible for pitch elevation. In the literature is a longstanding controversy revisited regarding the laryngeal and phonatory signs that should be considered indicative of unilateral ESLN paralysis/paresis. Paresis of the superior laryngeal nerve is one of the most frequent causes of dysfunction of this nerve, mainly occurring in the context of thyroid surgery, surgery of the cervical vertebrae and caused by viral infections. These lesions often have gone unrecognized in the past and the patients mistakenly have been referred to the speech therapist with an incorrect diagnosis of "functional voice disorder."

### METHODS:

In this retrospective study 10 patients with symptoms of restricted voice range, restricted loudness and voice fatigue were examined by following parameter:

Exact vocal history, Stroboscovideoscopy, Voice Range measurement., Acoustics analysing  
With four patients we confirmed the examination result by laryngeal electromyography

### DISCUSSION:

Some authors have concluded, that deviation of the petiole to the side of cricothyroid muscle weakness during high-pitched voice production represents a potential diagnostic sign of unilateral ESLN denervation

In our retrospective study all patients has had bilateral symmetrical vocal folds movement and a normal healthy mucosal situation, the upper voice range and the loudness in all patients were clear restricted, the deviation of the petiole was present in some cases. The frequent causes of these dysfunction disorders were in the context of thyroid surgery, surgery of the cervical vertebrae and idiopathic in two cases

The patients were treated by Principles of Lax Vox Therapy, Vocal Function Exercises according to Stemple and the Therapy principles for SLN Paresis according to Kruse (Göttingen) Posttherapeutic improvement was evident in all the parameters that were investigated

The authors suggest that voice range measurement is the most useful parameter for analyzing the effects of SLN paresis or paralysis on voice and in measuring the outcome following voice therapy, the diagnosis of .paralysis or paresis of the superior laryngeal nerve can be confirmed by laryngeal electromyography

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## Electromyographic Diagnosis in Vocal Fold Immobility

### *Introduction*

Vocal fold immobility is a well-recognized problem in patients with disordered voice and breathing. Laryngeal electromyography (LEMG) is helpful in the diagnosis of this clinical entity.

### *Objective*

To describe the usefulness of the laryngeal electromyography in the assessment of vocal fold immobility.

### *Study Design and Methods:*

Prospective case review.

### *Methods and Materials:*

All the patients with vocal fold immobility or hipomobility were referred to the voice clinic in order to evaluate the origin of the immobility. The main symptoms were dysphonia, dysphagia and dyspnea. Beside the clinical and endoscopic evaluation, laryngeal electromyography was performed. Cricothyroid and thyroarytenoid muscles were explored in all the patients.

### *Results:*

49 patients were received with the diagnosis of vocal fold immobility or hipomobility. All of them underwent voice assessment and videolaryngoscopic evaluation. In 39 patients we performed laryngeal electromyography. Neurogenic lesion was founded in 31 patients. The positive predictive value of the LEMG was 90% in cases of immobility and 60% in hipomobility. All patients received speech voice therapy. 8 patients needed surgical treatment: thyroplasty or injection laryngoplasty in cases of dysphonia or dysphagia and tracheotomy or botulinum toxin injection in cases of dyspnea.

### *Conclusion:*

Accuracy in diagnosis of vocal fold immobility can be increased with the use of LEMG.

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## **The Voice Fatigue Handicap Index (VFHI): Development and Validation**

All types of dysphonia are characterized by varying degrees of vocal fatigue which affects emotional, psychosocial and working conditions. To date no instruments exist to quantify and self assess emotional, psychosocial and working consequences of voice fatigue.

The aim of the present investigation was the development of a statistically strong Voice Fatigue Handicap Index (VFHI), a questionnaire consisting of 30 items, divided into 3 parts: disability, handicap and impairment. The development of this test was performed following attributes of content validity, internal consistency, reproducibility, reliability, responsiveness and interpretability.

VFHI questionnaires were completed by 60 subjects with voice complaints and 60 without voice complaints. VHI questionnaires were administered too for comparison and to assess validity. Voice recordings were made of a sustained vowel and of the word “aiuole”, repeated twice, to obtain perceptual analysis and to demonstrate validity. 30 tests per group were administered twice to 15 days apart in order to assess test-retest stability, reliability and reproducibility; 30 tests, in group of voice disorder, were administered before and after speech therapy for at least 8 sessions, on a weekly basis, to assess responsiveness.

The results were then analyzed using statistical criteria for both VFHI and VHI questionnaires.

We show results and statistical analysis to validate VFHI, to demonstrate its usefulness in clinical practice for spoken voice and to confirm the higher sensitivity of VFHI compared to VHI, especially in impairment and disability sections.

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## **Vocal Dosimetry and Voice Fatigue Index (VFI): A Way to Identify and Quantify the Vocal Fatigue (VF) in Opera and Musical Soloist Singers During Live Performances**

In clinical management of singers it's important to identify risk components of VF and glottic damage, predicting and assessing the vocal cost of the various vocal performances to avoid any risk.

We made dosimetries in classical and modern singers during live performances. Our aim was to evaluate phonatory behaviours before, during and after performances to determine the actual amount of vocal load and the possibility of assessing VF and performative potential risks through the identification of a VFI.

We conducted preliminary clinical assessments, interviews to know feelings of the singers about sung roles, examining different points of the score, to identify its difficult or fatiguing moments and rest times; then we made dosimetries in 3 different steps: during live performances in theatres (19 singers), outdoor (6) and before/after vocal warm-up or singing lessons (18).

Since the analysis of numerical data from APM (Fo, SPL, doses) doesn't immediately highlight the extent of vocal load, we decided to reprocess data in order to propose a new index: VFI.

We found that a lower VFI corresponds to difficult or fatiguing moments, while the opposite happens in moments of vocal rest or recovery.

In the study we used Fo histograms like real vocal score profiles, SPL histograms like real dynamic practicability and phonation density graphs like real phonetograms to point out many vocal features.

Through this method it could be possible to identify and quantify VF, in order to adapt technical and behavioural measures to prevent and reduce risks of VF or damage.

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## Characterization of Voice Disorders in Deployed and Non-Deployed United States Army Soldiers

**Objectives/Hypothesis:** Voice disorders can inhibit effective communication in any occupation. In the Armed Forces, compromised communication may impair fitness for duty or, in the wartime setting, have more dire consequences.

**Study Design:** Cross Sectional Study

**Methods:** To evaluate the incidence and characterization of voice disorders in the military, more than 1.3 million health records of active duty U. S. Army soldiers with no prior history of dysphonia were queried for new voice disorder diagnoses over a 3-year period. To further characterize these individuals, a statistically representative sample of more than 300 charts was retrospectively reviewed for job title, past medical history, smoking history, past surgical history, and voice therapy.

**Results:** The overall incidence of dysphonia was 32/10,000. Of the 450,000 soldiers deployed to Iraq or Afghanistan, there was a small, statistically significant, increase in relative risk, 1.073, over 840,000 non-deployed soldiers. In males, voice disorder diagnosis increased from 15/10,000 for those younger than 25, to 38/10,000 between 26 and 50 years of age, to 69/10,000 in those older than 50. Female soldiers in matching age groups had nearly double these incidences in a similar pattern.

**Conclusions:** Soldiers deployed to war zones, exposed to blasts, loud noise and frequent vocal misuse are more likely to be diagnosed with a voice disorder. An epidemiologic risk model provides a broad understanding of voice disorders and associated risk factors amongst Armed Forces personnel for surgeons, speech pathologists, and military planners. This represents the largest cross sectional study report in the literature.

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**Relation of Laryngeal Botox Dosage to Patient Age, Vitality and Socioeconomic Issues**

The current method of determining the optimal dosage of Botulinum toxin (Botox) for the treatment of spasmodic dysphonia remains intuitive at best. No formal guidelines exist to assist in determining an appropriate dose or anticipating when a change of dose may be necessary. Ideally, the dosage used gives the patient several months of good voice with minimal breathiness at the onset of the injection. The dosage variations reported in previous studies result from basing dosage on a subjective assessment of dystonia severity and type of injection- unilateral or bilateral. Recent studies have additionally presented evidence that the effective Botox dose not only increases with age, but also with the difficulty these patients encountered in accessing treatment. Such patients tend to tolerate higher doses and longer breathy periods in order to have more months with good voice. No study has investigated the patient's overall health as a factor in determining Botox dosage. This investigation examines the potential of indices of a patient's vitality to gauge Botox dosage. Factors investigated include body mass index (BMI) – with a normal BMI used as a rough correlate to lean muscle mass, "vigor" in daily activities by the SF-36 quality of life questionnaire, the voice-related quality of life questionnaire, and a patient estimate of voice use in relation to Botox dose. Also, the interaction between socioeconomic factors, such as cost of treatments and distance traveled to appointments, and the decision to tolerate higher doses of Botox and longer periods of breathiness are examined.

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**Correlation of the Voice Handicap Index – 10 (VHI-10) and Voice-Related Quality of Life (V-RQOL) in Patients with Dysphonia**

Voice disorders may interfere with patients' functional, physical, emotional and social wellbeing. Measuring the magnitude of this interference is an essential part of the clinical voice evaluation and may determine the course of treatment. Numerous instruments have been developed to accomplish this task. Such instruments include the Voice Related Quality of Life (V-RQOL), the Voice Handicap Index (VHI), and the abbreviated Voice Handicap Index – 10 (VHI-10). The VHI and V-RQOL have been shown to be highly correlated. However, to our knowledge no studies have compared the VHI-10 and the V-RQOL. The purpose of this investigation was to compare these two instruments in a large cohort of dysphonic patients. We performed a retrospective chart review of over 2000 patients who presented to our voice clinic during a two-year period. We will be reporting results of correlation analyses comparing the two instruments both in dysphonic patients in general and by diagnostic category.

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## **Diagnostic Delays in Spasmodic Dysphonia: An Ongoing Challenge and Call for Clinician Education**

*Purpose:* Spasmodic Dysphonia (SD) is a rare but often debilitating disease. Due to lack of awareness among practitioners and lack of well-defined diagnostic criteria, it can be difficult for patients with SD to receive a diagnosis and subsequent treatment. There is currently no literature documenting the efficacy of the medical community in recognizing and diagnosing this disorder. We aimed to determine the amount of time, as well as the type and number of physicians it takes for patients with SD to be properly diagnosed.

*Methods:* 107 patients with SD completed questionnaires about their experiences with SD. Patients were recruited either during their appointments for Botox injections at the Emory University Voice Center or during participation in an NIH funded study investigating SD. Questions focused on assessing the amount of time required for patients to be diagnosed after they initially sought treatment for their voice symptoms, as well as on the type and number of physicians it took to receive a diagnosis of SD. Data was also obtained on treatments used other than botox as well as the presence of dystonia in any site other than the larynx. Data was assessed to determine the average time to diagnosis as well as the average number of physicians seen prior to diagnosis.

*Results:* It took patients an average of 4.43 years (53.21 months) to be diagnosed with SD after first going to a physician with vocal symptoms. Patients had to see an average of 3.95 physicians in order to receive a diagnosis of SD. 33.6% of patients had seen a neurologist while trying to be diagnosed. 31.4% of patients had been prescribed medications other than botulinum toxin to treat their symptoms. 30% of patients attempted alternative therapies for treatment of SD, such as chiropractor or dietary modification.

*Conclusion:* Despite advances in diagnostic modalities in medicine the diagnosis of spasmodic dysphonia still remains elusive. Objective criteria for the diagnosis of spasmodic dysphonia and increased clinician education are warranted to address this diagnostic delay.

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### Endoscopy Findings in Children with Vocal Nodules

*Objectives:* The purpose of this study is to characterize the endoscopy findings in children presenting with vocal nodules/lesions.

*Methods:* Thirteen children, with a mean age of 7.5 years, have been enrolled in a study that characterizes vocal hygiene and voice complaints in children diagnosed with vocal nodules. The expected enrollment in this study is 40 children between the ages of 5 and 17 years. Children recruited for this study were seen for a complete voice evaluation at the Center for Pediatric Voice Disorders, Cincinnati Children's Hospital Medical Center. All children underwent videoendoscopy/stroboscopy.

*Results/Conclusions:* The current data for endoscopy findings and performance of endoscopy are as follows: 85% (11/13) underwent flexible endoscopy using a 3.2mm chip tip scope vs. 15% (2/13) underwent flexible endoscopy using a 2.4mm fiberoptic scope. 1 patient was able to tolerate rigid stroboscopy, 6 patients attempted rigid endoscopy unsuccessfully and 8 patient did not undergo rigid endoscopy. 38% (5/13) subjects had asymmetric lesions, 46% (6/13) had broad based lesions, and 46% (6/13) of the sample videos could not be used to rate mucosal wave. When a larger sample size has been obtained, correlations of endoscopy findings will be made with age and gender and perceptual findings. This information will provide a greater understanding of voice behavior and voice care throughout the school-age years in children with vocal nodules/lesions.

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**Self-reported Changes in the Professional Singing Voice Following Surgical Intervention Treatment for Breast Cancer- A Survey of Female Professional Singers**

**INTRODUCTION:** To date, definitive breast cancer research findings related to treatment effects on the professional singing voice have not been established.

**OBJECTIVE:** The purpose of this study is to discover self-perceived changes (if any) in the quality and/or process of singing experienced by professional female singers who have undergone surgical intervention for the treatment of breast cancer. Those singers who have had mastectomy and /or reconstructive surgery, as well as radiation therapy, chemotherapy, and other drug treatments associated with these surgical procedures will be specifically targeted.

**METHODS:** A voluntary subject pool composed of female professional singers who are or have been breast cancer patients treated with surgical intervention will be recruited from professional singing networks. These study participants will undergo evaluation through an anonymous on-line survey. A panel of experts has been chosen for content assessment, and instrument reliability/validity will be vetted according to psychometric standards prior to administration. Participants will supply relevant factors associated with their vocal perceptions using categorical responses, multiple choice answers, and scale ranking and open forms.

**DISCUSSION:** Discussion will focus on descriptive survey results and analysis with the intent to determine the degree of impact that surgical interventions related to breast cancer may have on the voice of the professional singer. Results of this survey may provide a platform for the subsequent delineation of expectations that other singers may consider when facing impending breast cancer treatments.

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**Frequency of Laryngeal Papilloma Recurrence Requiring Surgical Intervention Pre- and Post-Intralesional Cidofovir Treatment**

Treatment of laryngeal papillomatosis, a disease of the respiratory tract caused by the human papilloma virus (HPV), is challenging due its high recurrence rate. Varying degrees of success have been observed with both medical, surgical and combination treatments. Intralesional Cidofovir is considered an effective treatment for laryngeal papillomatosis though dose, frequency and efficacy are poorly studied. Because Cidofovir can be effective in prevention or as a surgical adjunct a study of the longitudinal frequency of papilloma recurrence was designed to support or refute the usage of Cidofovir in this disease process. A retrospective cohort design was used to study 50 patients with laryngeal papillomatosis treated with intralesional cidofovir injection during surgery. Papilloma grading and recurrence, frequency of surgical intervention and details of cidofovir administration were recorded and analyzed. Relative risk of pre and post-cidofovir treatment was calculated.

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## **Efficacy of Superdose Proton-pump Inhibitor Administration in Laryngopharyngeal Reflux**

Laryngopharyngeal reflux disease is a disease characterized by symptoms such as hoarseness, chronic cough, globus pharyngeus, chronic throat clearing, dysphagia and excess buildup intralaryngeal mucous. These symptoms manifest as a result of extraesophageal spillage of acidic and nonacidic contents resulting in predictable changes on laryngeal examination. Typical treatment includes once or twice daily dosing of proton-pump inhibitors (PPI). However, in selected refractory cases an increased frequency of dosage is prescribed despite a lack of supporting evidence in the literature.

50 patients with diagnosed LPR refractory to standard dosing were treated with three times daily or four times daily proton pump inhibitors. These patients were retrospectively studied with a review of both subjective and objective information. Patients had abnormal findings on pH impedance study showing acid production despite twice daily PPI usage. The voice handicap index was used to determine baseline and post-treatment subjective voice analysis. The Reflux Finding Scale (RFS) was utilized for objective assessment of rigid and/or flexible endoscopic evaluation, with specific consideration given to anatomical correlates of LPR diagnosis. Endoscopic examinations were evaluated by two blinded and two unblinded trained evaluators. Intra- and inter-rater reliability were tested using Pearson coefficients. Pre-treatment RFS was compared with post-treatment RFS. Additionally, post-treatment pH impedance testing was compared with pre-treatment testing when both were available. Results from the blinded evaluators were compared to the results of the unblinded evaluators evaluating the effect of “blinding” as well.

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### **Thyrohyoid Tendonitis – An Unrecognized Cause of Odynophonia**

Odynophonia is a frustrating problem for both patients and physicians. This problem often results from improper vocal use, such as muscle tension dysphonia, but can persist despite appropriate voice therapy. In some cases, pain along the thyrohyoid ligament is responsible and can be treated similar to the treatment of other types of localized inflammation. 10 patients with pain along the thyrohyoid tendon were treated with an injection of a half topical anesthetic and steroid mixture. These patients all experienced immediate and most experienced prolonged relief from their chronic pain in one or two injections. This study retrospectively evaluates the effect of this treatment and discusses this previously unreported phenomenon in the spectrum of odynophonia.

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**Transthyroidal Arytenoid Adduction Using a Small Bone Suture Anchor: First Clinical Results**

Arytenoid adduction is a very effective procedure for medializing the posterior part of the vocal fold in vocal fold paralysis. Major drawback of the method is the technically sometimes difficult access to the arytenoid with increased postoperative morbidity. In an anatomical study we could show that there are constant morphometric relations between a standard thyroplasty window and the arytenoid cartilage. We also could identify normative data for angles and distances from the surface of the thyroid to the arytenoid cartilage. The fovea oblonga near to the muscular process of the arytenoid turned out to be the most favorable point for fixation of a surgical screw. In human laryngeal specimens we could show that anchoring of the screw is possible without problem and pulling the attached suture medializes the posterior part of the vocal fold. Based on these investigations we started with the clinical application in patients with unilateral vocal fold paralysis undergoing a medialization laryngoplasty. Our first clinical experiences proved that this technique is easily applicable and a good medialization with excellent voice outcome could be achieved.

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## **Efficacy of Anti-reflux Surgery on Refractory Laryngopharyngeal Reflux Disease in Professional Voice Users: A Pilot Study**

Background: Laryngopharyngeal reflux (LPR) has been recognized as a major cause of dysphonia in a majority of patients with voice disorders. Singers in particular suffer from LPR as the proper usage of abdominal musculature in breath support compresses the stomach promoting backflow of gastric contents. Traditionally, LPR is treated with dietary and lifestyle modifications as well as medical therapy. However, lack of response to traditional treatment, cost, and dissatisfaction with and consequences of long-term medical therapy remain major problems. Laparoscopic Nissen fundoplication (LNF), a well-studied and verified procedure for the treatment of GERD, has also been proposed as a treatment for LPR refractory to standard and superdose medical therapy. Many studies have attempted to evaluate the effectiveness of this procedure for LPR; but results have been mixed with some studies showing clear benefits while others show little improvement. The purpose of this pilot study is to elucidate further the effectiveness of LNF in a defined cohort (singers and other professional voice users) with LPR in the hope that improved perspective will lead to future study on a larger population.

Objectives: Assess the short and long-term efficacy of anti-reflux surgery (LNF) in treating refractory LPR in singers and other voice professionals.

Study Design: Retrospective cohort

Study Population: 20 professional voice users with diagnosed LPR refractory to medical therapy who subsequently underwent Nissen fundoplication.

Data: Parameters compared pre and post-operatively included both subjective and objective measures: dose and dosing frequency of reflux medication, endoscopic laryngeal evaluation (reflux finding scores), 24 hour dual pH measurements, voice handicap index, and other quality of life indicators.

Conclusion: Anti-reflux surgery (Nissen fundoplication) is effective in improving symptoms, signs and objective measures of LPR and improves quality of life in patients on both a medium and long-term basis.

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## **Injection Vocal Fold Augmentation: Comparing Cepstral Measures with CAPE-V and Videostroboscopic Ratings**

Medialization injection of an immobile vocal fold is a common procedure for laryngologists. Previous studies have assessed the effects of medialization using subjective auditory-perceptual and videostroboscopic ratings. Cepstral analysis has emerged as an important objective measure in the acoustic analysis of treatment effects, but has only been reported in the setting of fat medialization procedures. The purpose of this study is to determine the effects of calcium hydroxylapatite injection by comparing outcomes of cepstral and spectral-based acoustic measures with auditory-perceptual and stroboscopic ratings. Acoustic measures that had strong differential and predictive capacity for dysphonia were used, including cepstral peak prominence (CPP), the ratio of low to high frequency spectral energy, and the standard deviations of each. Consensus Auditory Perceptual Evaluation of Voice (CAPE-V) and stroboscopic functional ratings were utilized as standards to which the acoustic results can be compared. This study implements a retrospective analysis of pre- and post-treatment voice recordings, stroboscopic video recordings, and data from chart reviews. Patients who received calcium hydroxylapatite injection for unilateral vocal fold paresis between January 2006 and August 2011 at the Syracuse Voice Center were included in this study. Blinded auditory-perceptual ratings of overall voice severity were performed by experienced voice clinicians on the pre- and post-treatment, randomized audio recordings using the CAPE-V. Stroboscopic videos were randomized and rated by blinded, experienced clinicians based on the “edge factor” and “vibration factor” criteria. The pre- and post-treatment audio files were also analyzed acoustically to derive the cepstral and spectral-based acoustic outcomes.

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## **Type and Severity of Pain During Phonation in Professional Voice Users and Non-vocal Professionals**

*Objective:* The purpose of this study was to determine the presence, frequency and intensity of pain during speaking in professional voice users and non- vocal professionals and to determine if the presence of pain is significantly related with the profile of the professional voice user. Based on the available literature significantly more pain symptoms in professional voice users can be hypothesized.

*Study design:* sample survey

*Methods:* To characterize the presence, type and degree of pain symptoms during speaking, a questionnaire was used. Pain severity was measured by means of a Numerical Rating Scale.

*Results:* Fifty five (176/320) percent of the non-vocal professionals and 84% (698/832) of the professional voice users mentioned the presence of one or more pain symptoms during speaking. Throat pain was mentioned as the most common pain in both the professional and non-vocal professional voice users. The professional voice users showed significantly more throat, neck, shoulder, headache, ear and back pain. Moreover the intensity of throat pain was significantly increased in the professional voice users.

*Conclusions:* This study showed evidence that several types of pain are present with significantly greater frequency in professional voice users. Vocal screening strategies, diagnostic and treatment protocols should include the assessment of the type and severity of pain. Currently, the voice clinic is working on improving the diagnostic protocol with the objective of defining the combination of tests which best diagnose voice problems and related complaints and which evaluate progress in vocal characteristics and pain after rehabilitation.

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## Comparison of the Perceptual Quality of Different Voice Samples

**Background:** Different types of voice samples are commonly used in perceptual evaluation of voice. Even though it has been advocated that the choice of voice samples should truly reflect a person's everyday speaking voice, no studies so far have included the use of conversational speech sample. Hence, the goal of this research is to investigate whether there are perceptual differences between conversational speech and other types of voice samples.

**Methodology:** Forty speakers with a total of 150 voice samples were randomly presented to fourteen speech therapists experienced in voice disorders. Each speaker contributed to a sample on vowel sustaining, passage reading and conversational speech. Ratings are made on four vocal parameters, overall severity, roughness, breathiness and strain, on a 10-point equal-appearing interval scale.

**Results:** Results using repeated measures of ANOVA showed no statistically significant effect on the perceptual quality across types of voice samples as a whole. However, the perceptual quality on different types of voice samples appeared to vary across vocal parameters. Follow-up analysis of individual parameters showed the differences in perceptual quality across voice sample types were evident on breathiness and strain during vowel sustaining and passage reading respectively. Although these differences were noted, their effect was relatively small.

**Conclusion:** This study revealed that vocal quality is relatively stable across different types of voice samples. Although a difference in perceptual quality on different types of voice samples were note on certain vocal parameters, these effects were relatively small and may not contribute to clinical differences.

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## Cross-Cultural Adaptation and Validation of The Voice Symptom Scale – VoiSS into Brazilian Portuguese

*Purpose:* To validate the Voice Symptom Scale – VoiSS into Brazilian Portuguese and to perform the factorial analysis of its questions.

*Methods:* 300 individuals, 160 with vocal complaints and 140 without vocal complaints. The validation was performed according to the criteria of the Scientific Advisory Committee of the Medical Outcomes Trust. Factorial analysis was performed after completion of the validation. *Results:* The translated and culturally adapted version was called *Escala de Sintomas Vocais – ESV* and maintained its original 30 questions and three domains: impairment (15 questions), emotional (8 questions) and physical (7 questions). *Validity:* significant difference was found between total score and vocal self-assessment data ( $p < 0.001$ ). *Reliability:* high levels of internal consistency (Cronbach's alpha for subscales were as follows: impairment =0.950, emotional=0.810, physical=0.913, total=0.960, all with  $p < 0.001$ ) and excellent test-retest reproducibility (impairment:  $p = 0.265$ , emotional:  $p = 0.481$ , physical:  $p = 0.585$ , total:  $p = 0.905$ ). *Responsiveness:* the *ESV* showed to be responsive to treatment, as partial and total scores, and voice perceptual analysis results were statistically different when compared before and after voice therapy (impairment, physical, total, and perceptual analysis:  $p < 0.001$ , emotional:  $p = 0.008$ ). The factorial analysis indicated nine factors: 1-emotional (5 questions), 2-functional (6), 3-vocal performance (6), 4-phlegm (3), 5-sound of voice (2), 6-throat sensation (3), 7-vocal pleasantness (3), 8-vocal instability (1) and 9-singing voice (1).

*Conclusions:* The Brazilian version of VoiSS, called *ESV*, is a valid, reliable and responsive protocol to assess individuals with vocal complaints. Factorial analysis revealed nine consistent factors for the Brazilian version.

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**Does “Glee” Culture Get It?: Assessing Vocal Health Awareness and Experience Among College Students Involved in Extracurricular Singing Groups**

Background: College students in extracurricular singing (i.e., A cappella) groups often sustain vocal injuries related to poor vocal hygiene and voice overuse. These groups usually have extremely demanding rehearsal and performing schedules, led by students who do not possess adequate knowledge of voice care. When the dysphonic student is evaluated in the voice clinic, clinicians make recommendations for improving vocal pacing and hygiene as part of the treatment plan to restore vocal health. Achieving optimal clinical outcomes can prove a challenge for the voice clinician and student. This may be a result of generalized difficulty adhering to healthy lifestyle (moderating caffeine and alcohol intake, adequate sleep, etc.), as well as the students’ perception that modifying voice use will decrease participation in singing and social activities. This issue underscores the importance of understanding students’ knowledge of vocal hygiene and pacing to develop dysphonia prevention initiatives targeting this vulnerable population.

Method: An electronic survey was developed using the SVHI-10 and a modified version of the Voice Knowledge Questionnaire to assess subjects’ knowledge of vocal hygiene and vocal pacing, as well as perceived incidence of vocal difficulty. A link to the survey accompanied by full disclosure of the study was emailed to student leaders of college extracurricular singing groups in North Carolina. Student leaders were asked to forward the survey to members of their singing group. Participation in the survey is voluntary and anonymous. Results are collected and summarized using the survey website.

Results: This study is currently underway.

Conclusions: Pending study results.

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### **Effect on Closed Quotient of Resonance Tubes and Phonation with Vibrato**

Exercises with partial occlusion or lengthening of the vocal tract have been widely used in voice therapy for both the singing voice and the speaking voice. Phonating into narrow hard-walled tubes of varying diameters and length as an extension of the vocal tract is one these techniques labeled as semi-occluded vocal tract exercises. Semi-occluded vocal tract postures appears to affect at least two components of voice source function: 1) glottal flow pulse and 2) vibrational characteristics of the vocal folds. Vibrato also has been described as a possible therapeutic tool to decrease phonatory hyperfunction. The aim of this study is to determine the influence of resonance tubes and phonation with vibrato on the closed quotient. Twenty-nine classical singers were recruited for this study. Each subject has at least five years of classical voice training. Subjects were screened for voice complaints. Any singers with voice complaints in the last year were excluded. Subjects were asked to produce four phonatory tasks at comfortable pitch and loudness level: sustained vowel /a/ without vibrato, sustained vowel /a/ with vibrato, sustained pitch into a straw without vibrato, sustained pitch into a straw with vibrato. Computer analysis of closed quotient was done in each type of phonation in every participant. We obtained a general average of closed quotient for each phonatory task. Using repeated measures analysis of variance (rmANOVA) parameters were compared to assess the effect on closed quotient of resonance tubes and phonation with vibrato.

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### **The Effects Semi-Occluded Vocal Tract Exercises on Singers**

**Abstract:** This study describes within speaker differences in laryngeal activity as a function of hums, voiced lip trills, voiced raspberries, and sustained vowels produced by 10 singers. Flexible fiberoptic laryngeal endoscopy/stroboscoty is completed along with electroglottography (EGG). Closed quotient (from EGG) and glottal configuration, mucosal wave characteristics, and other laryngeal activity (from imaging) will be compared within singer across tasks. CQ is expected to be reduced and glottal configuration more open during semi-occlusion tasks; there is not a clear expectation about whether the three semi-occlusion tasks will influence laryngeal activity similarly within or across singers.

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## **The Progress toward Construct and Criterion-Related Validation of the Cantonese Perceptual Evaluation of Voice (CanPEV)**

*Background:* Following our work on content validation, this study provides the results of the progress in the construct and criterion-related validation process of a perceptual evaluation of voice scale.

*Methodology:* Fifty-eight raters completed voice ratings using the first-version of the CanPEV scale which consisted of 22 vocal parameters. CanPEV scale was subsequently subjected to an array of construct validation processes. Structural validity were assessed using (1) item response theory (IRT) for rater and parameter selection; (2) factor analysis to assess the underlying structure of the vocal parameters; (3) correlation among parameters with expert opinion for parameter elimination; and (4) discriminate validity with voice-related quality-of-life measure. Convergent and divergent validity was measured against demographic variables of the speakers. For criterion-related validation, concurrent validity was assessed using the ratings of GRBAS.

*Results:* Results of IRT indicated that the ratings from 48 raters were deemed reliable for further analysis. IRT also excluded seven vocal parameters due to the lack of fit in their ratings. Of the remaining 14 vocal parameters, factor analysis identified a one-factor model. A further 4 parameters were eliminated after expert consultation due to a high correlation with other vocal parameters. Discriminate validity, convergent and divergent validity were shown to be good. Results of the concurrent validity indicated that a high correlation between the vocal parameters in CanPEV and GRBAS.

*Conclusion:* Construct and criterion-related validation is crucial in a test validation process. CanPEV is the first ever perceptual evaluation of voice scale that utilized a range of test validation process.

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### **Spectral and Cepstral-based Acoustic Features of Dysphonic, Strained Voice Quality**

Cepstral and spectral-based acoustic measures have shown excellent discriminative capacity and strong correlations with voice severity ratings. Relationships between these acoustic measures and voice quality dimensions of breathiness and roughness have been well studied, but little is known about the acoustic features of strained voice quality. Strain is evidenced frequently in a variety of voice disorders, occurring as a primary or secondary, compensatory feature in voice disorders with non-organic, organic and neurological etiologies. The purpose of this study was to determine whether a set of cepstral and spectral-based acoustic measures were effective in distinguishing dysphonic speakers with a predominant voice quality of strain from normal speakers, and whether these measures were correlated to auditory-perceptual voice quality ratings. Sustained vowel and continuous speech samples from 23 speakers with dysphonia characterized predominantly by strained voice quality and 23 speakers with normal voice were acoustically analyzed. Measures related to the prominence of the cepstral peak (CPP) and the ratio of low-to-high frequency spectral energy (L/H Ratio), as well as the standard deviation (sd) of each, were computed. Measures related to the cepstrum were the strongest discriminators between dysphonic-strained and normal voice, with significant between-group differences in continuous speech for CPP and CPP sd, as well as the L/H ratio sd ( $P < .001$ ). All measures were significantly correlated with perceptually rated strain severity ( $P \leq .004$ ), including an acoustic severity index that incorporated both cepstral and spectral-based measures.

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### **Perceptual and Acoustic Similarities of Voices Among Family Members**

Human beings have many characteristics that make it possible to distinguish one individual from another which can be perceived very rapidly such as facial features vocal quality and behaviors. There are chances of mistaking the sound alike like mothers and daughters voice, or fathers and sons voice atleast through telephone. This has important application in forensic speaker identification when the crime has happened in a family. The present study was intended to find out the perceptual and acoustical similarity of the mothers and daughters' voices in field recorded condition.5 Kannada speaking mother–daughter pair consisting of 18-20 year old girls and their corresponding mothers aged 40-55 years were selected for the study. Words in Kannada embedded with long vowels /a/, /i/ and /u/ in the medial positions were considered for perceptual and acoustic analysis. Foils were made with each mothers voice sample paired with the entire 5 daughter for each vowel (m1-d1a, m1-d2a etc). A 4 point perceptual rating scale based on percentage similarity has been developed. The stimulus were given to five judges who were trained SLP's. The SLP's has to judge the similarity between the stimuli in the presented foils and mention the characteristics considered for rating. The vowels will be acoustically zoomed using CSL 4500 software and the melfrequency cepstral coefficient will be extracted for each vowel. The results show that the perceptually correct identification of the pair through their voices is below chance level. This may be due to the physiological and morphological differences between the vocal tracts or due to the changes in speaking style. Acoustic analysis is still in progress and the results will be discussed in terms of percent correct identification.

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### Acoustic Features of Radio Performers' Voices

*Introduction:* The acoustic features of supranormal (better-than-normal) vocal performers e.g. actors and singers are well-documented (e.g. Barrichelo et al, 2001; Bele, 2006). Measures such as alpha ratio, speaker's/singer's formant and fundamental frequency have been useful in quantifying these voices and differentiating them from non-performing controls. Radio professionals are a subgroup of supranormal vocal performers. This pilot study will explore the acoustic differences between radio performers and non-performing controls.

*Method:* Male radio performers (n=15, mean age=36yrs including announcers, voice-over artists and newsreaders) and matched male controls with no history of voice disorder or professional vocal performance (n=15, mean age=36yrs) participated as pilot groups. Participants were recorded reading a standard passage in two conditions: 1) as if in conversation outside the sound booth (habitual) and 2) as if presenting on the radio (performance). Cepstral Peak Prominence (CPP) (Hillenbrand & Houde, 1996) and Alpha Ratio (AR) (Sundberg & Nordenberg, 2006) were calculated for each voice sample. Factorial group x condition ANOVAS were conducted for CPP and AR.

*Results:* There were no significant interactions between group and condition for CPP or AR and no main group effects for both measures. There was a main effect for condition ( $p=0.021$ ,  $p=0.002$ ) seen for both measures across both groups.

*Discussion:* There were no differences between voices of radio performers and controls for CPP and AR. Differences between conditions may be due to a practice effect. These results contrast with our preliminary auditory-perceptual analysis and other previous studies (Medrado et al, 2005) where voices of radio performers were easily identified from controls. Continued data collection/analysis will examine specific characteristics of radio performer sub-types e.g. voice-over artists vs newsreaders as well as measures of Long Term Average Spectrum, fundamental frequency and detailed perceptual analysis.

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**A Study of Voice Offset Patterns in Young Female Voices with High-Speed Videoendoscopy**

Vocal fold pliability and its changes associated with scar and aging often lead to irregular vibratory behavior and limited assessment with videostroboscopy. High-Speed Videoendoscopy (HSV) does not rely on ordered vibration and is capable of assessing these irregular vibrations. Previously unmeasurable vibratory characteristics are also evaluable with this sensitive tool. In this study, we investigated the behavior of vocal folds during the voice offset period (VOP), defined as the time from gradual increase in the closed-phase glottal area until the complete cessation of vocal fold vibration. We hypothesize that VOP is an indicator of the pliability of the vocal folds. As an initial step investigating this hypothesis, we measured the stability of this phonation segment within and between recording sessions. The HSV recordings of fourteen young females with normal voices were used to obtain preliminary VOP values for this population. The HSV data was analyzed objectively and subjectively to determine the mean VOP values and whether VOP differed within and between recording sessions. The number of glottic cycles in VOP and the number of glottic cycles from the last true vocal fold contact to the end of oscillation were determined. The results demonstrated that VOP values did not differ significantly within and between recording sessions for the same subject. However, VOP values differed significantly between subjects. The implications of this unique phonatory segment and future research will be discussed.

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## Acoustic Analysis of Children's Voices with Different Hearing Amplificatory Devices

*Objectives:* The study intends to analyze and compare the acoustic characteristics of voice of prelingually hearing impaired children who are using a) Hearing aid/s b) Cochlear implantation and with that of normals.

*Methods:* The study consisted of 20 hearing impaired children (10 hearing aid users and 10 cochlear implant users) who were fitted with hearing device before the age of 1-1.5 years, and 10 normal hearing children as controls. They were divided into 3 groups. Group 1- Normal hearing children, Group 2- Children using hearing aid, and Group 3- Children with cochlear implantation (CI). Five synthetic sentences consisting of target Kannada sounds such as /a/, /i/ /u/ were prepared. Spectrographic evaluation was carried out using PRAAT software for analysis of voice onset time, three formant frequencies.

*Results:* The performance of the Cochlear implantees was better when compared to hearing aid using children in majority of the acoustic parameter. When compared to normal hearing children, cochlear implantees obtained mean scores similar to or near normal scores. This study indirectly suggests that cochlear implantees hear well. Hence, produce better speech.

The results of the present study would help the professionals to counsel the caregivers and parents regarding the advantages and usefulness of choosing cochlear implants in terms of better speech production skills over hearing aids. The acoustic values will suggest the Speech Language pathologist to form a baseline for speech intervention process for children using different type of auditory prosthesis.

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**A Laryngeal Waveform Model to Describe Vibratory Characteristics in Benign Lesions of Vocal Folds Obtained with High-Speed Videoendoscopy**

High-speed videoendoscopy (HSV) has the potential to become an invaluable clinical tool in vocal fold assessment; however, its clinical utility remains elusive. Harnessing HSV data with objective analysis is thought to be a key step in its practical application.

Since many characteristics of the acoustic voice signal are also present in HSV data, acoustic analysis techniques are often applicable to analyze waveforms extracted from HSV data. Our HSV waveform modeling effort is based on Titze's voice signal types: dominantly harmonic (Type I), coexistence of harmonics and non-harmonic contents (Type II), and absence of harmonic structure (Type III). A laryngeal waveform is modeled as a sum of three components: periodic signal, deterministic noise, and random noise. The deterministic noise is a sum of sinusoids that do not belong to the harmonic structure of the desired voice signal and is often the main constituent of the Type-II and Type-III signals. Strong deterministic noise worsens the voice quality more than equally strong random noise. We have applied this model to the glottal area waveforms from HSV data (recorded at 2,000 frames per second) and studied five specific parameters derived from the model between two groups, normal and pathology, and also within the pathology group (pre-surgery, post-surgery less than two weeks, and post-surgery after one month.) The statistical analysis reveals that the pre-surgery group shows significant difference from all other groups in three of the parameters: long-term fundamental frequency perturbation, harmonics-to-total-noise ratio, and harmonics-to-deterministic-noise-ratio.

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## **Objective and Perceptual Outcome Measures of Behavioral Therapy for Athletes with Paradoxical Vocal Fold Motion**

Paradoxical vocal fold motion (PVFM) is a condition that decreases airway patency caused by the vocal folds adducting during inspiration. Its underlying pathophysiology is unknown. Varying triggers are reported for symptom onset; the most common is physical activity. Behavioral therapy that focuses on diaphragmatic breathing taught by speech-language pathologists is the treatment of choice, yet empirical evidence to support treatment effectiveness is lacking. We propose that respiratory resistance ( $R_r$ ) measured by the Airflow Perturbation Device (APD) may supplement indirect laryngoscopy and provide quantitative outcomes of treatment success.

In the current study, four female athletes having a mean age of 14.75 years were diagnosed with PVFM through indirect laryngoscopy following a treadmill exercise challenge. Each received five therapy sessions that focused on respiratory retraining during rest and exercise. The duration of therapy averaged 8.33 months. At each session,  $R_r$  measures were taken during rest breathing and following an exercise challenge where exercise duration and dyspnea ratings were recorded. The athletes also rated perceived symptom frequency, severity, practice amount, symptom improvement, treatment effectiveness, and sense of control. Laryngoscopy was performed following exercise during the last treatment session.

The two youngest athletes experienced a decrease in inspiratory and expiratory resistance during post-exercise breathing that correlated with improved symptom ratings and sense of control. PVFM was not observed through indirect laryngoscopy. The other two athletes continued to experience an increase in inspiratory resistance and ongoing PVFM symptoms. All athletes reported reduced dyspnea ratings during exercise. There was a strong positive correlation between reported amount of technique practice and treatment success. Our results suggest that behavioral therapy may provide relief from physical symptoms associated with PVFM and measures  $R_r$  may provide evidence of treatment effectiveness.

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## Vocal Tract Discomfort in Teachers: Its Relationship to Self-Reported Voice Disorders

*Objective:* To verify vocal tract discomfort in teachers and to determine its relationship to the presence of self-reported voice problems (S-rVPs), vocal signs and symptoms, voice self-assessment and perceptual analysis of voice quality.

*Methods:* 32 teachers with vocal complaints and 30 teachers with no complaints. Procedures: demographic questionnaire, signs and symptoms questionnaire, Vocal Tract Discomfort (VTD) Scale, vocal self-assessment and perceptual analysis of voice.

*Results:* The S-rVPs group presented with higher frequency of all vocal signs and symptoms and also had greater frequency and intensity of discomfort than teachers without complaint, for all analyzed items ( $p < 0.05$ ). The group with S-rVPs experienced more than twice the level of discomfort than the group without S-rVPs (mean 6.3 versus 2.8 symptoms,  $p < 0.05$ ). Teachers with voice problems felt at least three symptoms of discomfort, whereas some teachers without complaint did not have any discomfort. We found a correlation between self-perceived voice and VTD. On the other hand, there is little correlation between discomfort and perceptual analysis of voice quality. Vocal tract discomfort is also associated with specific voice signs/symptoms that might indicate an incipient voice disorder.

*Conclusion:* This study reveals the importance of understanding subjects' perception of their own problems so that issues experienced by patients which are not directly apparent to the clinician can be addressed in treatment. Symptoms related to the vocal tract must therefore be given consideration to ensure a comprehensive and more relevant approach to the needs of patients.

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### **Voice Responses to Sudden Noises: A View into the Emotional Voice**

The Trait Theory of Voice Disorders, put forth by Roy and Bless (2000) suggested that those with behaviorally mediated voice disorders possess differences in temperamental traits than those with medically mediated voice disorders or controls. This theory has been tested in various voice disordered and control populations. However, direct measures linking temperamental traits (individual differences in emotional processing) and voice measures remain elusive. This research will present results showing that in negative states, the electroglottography closed quotient on the vowel /u/ is greater than in positive or neutral states suggesting volitional voicing is responsive to emotional states. It will also validate electroglottography closed quotient in response to a startle probe during positive, negative, and neutral states. The startle probe is a well-researched method of assessing unconscious emotional processing which relies on a generalized response of surprise (e.g., eye blinks, shoulder activation, and breath holding) to a sudden, loud burst of noise. In negative emotional conditions this startle probe elicits greater activation of response and in positive conditions; the opposite is true. When using electroglottography to assess the amount of vocal fold contact of breath holding, one can observe a direct, unconscious vocal response to emotional conditions. Electoglottography from twenty healthy control participants who experienced a startle probe during emotion induction will be presented. By combining voice science measures with affective science methodologies, we can begin to assess differences in voice processing, both volitionally and unconsciously, in emotional conditions and test the behavioral validity of the Trait Theory of Voice Disorders.

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## Characterization of Vocal Hygiene and Voice Complaints in Children with Vocal Nodules

*Objectives:* The purpose of this study is to characterize the vocal hygiene/parent-reported voice complaints in children presenting with vocal nodules.

*Methods:* Thirteen children, with a mean age of 7.5 years, have been enrolled in a study that characterizes vocal hygiene and voice complaints in children diagnosed with vocal nodules. The expected enrollment in this study is 40 children between the ages of 5 and 17 years. Children recruited for this study were seen for a complete voice evaluation at the Center for Pediatric Voice Disorders, Cincinnati Children's Hospital Medical Center. The intake history, completed by the caregiver, included the following vocal hygiene/voice complaint information: exposure to tobacco smoke; amount of daily liquid intake; amount of daily talking; occurrence of phonotrauma; change in voice quality throughout the day; and, occurrence of abnormal voice characteristics related to hoarseness, breathiness, pain, effort, and fatigue.

*Results/Conclusions:* The current data for vocal hygiene/voice complaints are as follow: exposure to tobacco smoke (25%); average daily liquid intake (6.6 cups); excessive amount of daily talking (39%); phonotrauma (62%); daily change in voice quality (92%); hoarseness (100%); breathiness (70%); pain (15%); effort (92%); fatigue (46%). When a larger sample size has been obtained, correlations of vocal hygiene characteristics and voice complaints will be made with age and gender. This information will provide a greater understanding of voice behavior and voice care throughout the school-age years in children with vocal nodules.

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## **Correlation of Perceptual Voice Quality with Acoustic and Aerodynamic Measures in Children with Vocal Nodules**

*Objectives:* The purpose of this study was to examine the relationship between perceptual voice quality and acoustic/aerodynamic measures in children with vocal nodules.

*Methods:* Thirteen children, with a mean age of 7.5 years, have been enrolled in the study thus far (expected enrollment = 40 children). These children were seen for a complete voice evaluation at the Center for Pediatric Voice Disorders, Cincinnati Children's Hospital Medical Center. The Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V) was utilized to assess the roughness, breathiness, strain, pitch, and loudness components of voice. Acoustic measures consist of maximum phonation time, maximum phonatory frequency range, and mean fundamental frequency. Aerodynamic measures include estimated subglottal pressure (Ps) and average airflow during voicing.

*Results/Conclusions:* Preliminary analysis of the data included Pearson rho correlations and linear regression models to characterize the relationships between perceptual voice quality and acoustic and aerodynamic measures. Findings thus far reveal that overall CAPE-V score was associated with increases in estimated Ps ( $p=.02$ ) and average airflow rate ( $p=.05$ ), and decreases in maximum phonation time after adjusting for age ( $p=.06$ ). The sub-parameters of roughness ( $p=.01$ ) and strain ( $p=.02$ ) were also associated with increases in estimated Ps. These correlations will be discussed related to the physiologic/anatomical changes that occur during voicing with vocal fold nodules.

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## **Can You Hear Me Now? The Effectiveness of a District-wide Voice Amplification System**

Voice amplification systems have been found to be effective in reducing vocal effort and are often used by teachers experiencing vocal difficulties. Some school districts, even in difficult economic times, are employing sound-field amplification systems prophylactically to increase teaching effectiveness and decrease incidence of teachers' voice problems. One school district's implementation of an FM system enabled the collection and analysis of data on the effectiveness and efficiency of voice amplification. Using questionnaires, this study investigated the degree of compliance of system use, changes in habitual voice use, changes in prevalence of reported voice problems, and changes in student behavior in the classroom. Because the respondents included all teachers and were not limited to those with voice problems, results present a reduced response bias inherent in surveys directed toward voice disorders alone. Further, the use of one single amplification system reduced confounds that differing systems often present in surveys addressing amplification use. Results revealed a high degree of compliance with use (78.1%), improved vocal behaviors by teachers in the classroom regardless of past vocal difficulties (79.2%), a reduction in symptoms of vocal overuse (33.7%), and the perception of improved teaching effectiveness. Unexpected results included improvement in student behaviors in the classroom (88.7%) and improvement in student performance (45.1%). Survey results support other research findings, broadening the use of amplification as a tool for prevention. Conclusions from this study can serve as a backdrop for future experimental research into effective amplification systems that facilitate balancing voice health and effective student learning.

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### **Perceptual Skill in a Professional Impersonator**

The process of imitation includes not only an incredible ability to reproduce vocal characteristics of a target speaker, but although to select them. In previous studies, we showed that the impersonator eliminates what is already natural to him, and then he selects and reinforces what he considers as a fundamental characteristic of the target. This incredible pertinence lies probably as much in his perceptual skills, than in his talent for modify his voice..

The aim of this study is to compare the abilities of perception between a professional imitator and control auditors. Our hypothesis is that a professional imitator has a capacity of perception better than the control listeners. This will be investigated by testing the ability of imitator and listeners either to detect stress differences with an ABX discrimination task involving an accent contrast (for example: bópelo/bopélo or bopélo/bopeló) or a phoneme contrast (a single phoneme change in one of the syllable).

We were inspired by the work of Emmanuel Dupoux, A destressing "Deafness in French?" published in Journal of memory and language, 1997 who tested two populations (spanish et french) of subjects on the same materials to determine whether the difference, spanish but not french uses accent to contrast between words, has an impact on the perceptual capacities of listeners.

As Emmanuel Dupoux, the triplets were recorded by speakers of Dutch (male and female). Dutch is a stress-timed language, which allows accent to appear in difference places in words. Results will be presented.

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## Vocal Impact of a Prolonged Reading Task in Dysphonic versus Normophonic Female Teachers

The purpose of this study is to evaluate the impact on voice of a 2-hour reading task between 70 and 75 dB in 16 normophonic and 16 dysphonic female teachers.

Method and material:

Every 30 minutes, serial sets of acoustic analysis are obtained. First, we analyze acoustic parameters as average fundamental frequency [F0], jitter percent, shimmer percent [Shim] and noise-to-harmonic ratio by use of Multi-Dimensional Voice Program. We also measure the lowest frequency [F-Low], the highest frequency [F-High], the frequency range [F-Range], the lowest intensity [I-Low], the highest intensity [I-High] and the intensity range [I-Range] using the Voice Range Program. Second, we measure aerodynamic parameters as maximum phonation time [MPT], estimated subglottal pressure [ESP] and sound pressure level [SPL] by use of the Aerophone II.

Results:

Concerning the acoustic analysis, repeated-measures ANOVA indicate that F0, F-Low, F-High, F-Range, I-High and I-Range increase during the prolonged oral reading, whereas Shim decreases. As far as aerodynamic measurements are concerned, MPT decreases after 30 minutes of reading, whereas ESP and SPL progressively increase during the first hour, and then decrease for both groups.

Concerning the comparison between the two groups, there is a higher F-High value, a greater F-Range and a lower ESP in normophonic teachers than in dysphonic teachers.

To conclude, the improvement of acoustic parameters seems to reflect an adaptation to vocal loading through time for both groups. Adversely, the aerodynamic parameters evolution suggests some effects of the long duration.

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### **Training TV Journalists for Efficient Communication**

SLPs are usually trained to work with dysphonic voices and not with normal and “supranormal” (better than normal) voices. An SLP working in broadcast television faces professional voice users that need, not only to have normal voice, but be efficient in their speech and communication. For this to happen they must have a good voice, clear articulation, language skills, adequate facial expressions and gestures, emotional expression and control.

Different from actors and singers, TV journalists do not have training, although they are using their voices and bodies to be successful in their functions. TV coaching and consultants in the speech area for broadcast television are rare, not only in the USA, but internationally.

To have an efficient communication the journalists need: voice and speech evaluation and training, development of language skills, body awareness and self-perception besides emotional expression and control.

This paper intends to present the improvement in a group of TV journalists towards more efficient communication. The necessity of change was determined by the company due to a historical change in the country’s economy and society. The experience was very successful and ratings improved significantly.

There will be presented and discussed the aspects of voice parameters, articulation, body gesture and posture in order for them to look and sound more natural and authentic, thereby conveying more credibility to the message.

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## **The Effects of Aging on Acoustic and Electroglottographic Parameters of Voice**

*Objectives:* Phonatory parameters of individuals over age 70 are absent for Iranian speakers. The purpose of the current study was to obtain preliminary normative acoustic and electroglottographic data of voice for elderly Iranian male and female speakers.

*Methods:* Voice samples from 21 male and 20 female elderly speakers aged 70 to 80 years and 20 young and middle aged males and 20 young and middle aged females, aged 20 to 49 years old as control group, were obtained on measures of 5 selected Dr.Speech4.3u Program acoustic parameters.

*Results:* The value of F0 was greater for elderly males than for young and middle aged males.

Conversely, this value was greater for control group than for elderly females.

Jitter and Shimmer values were significantly greater for elderly males and females than for the young and middle aged males and females.

In addition, the value of HNR was significantly greater for young and middle aged males and females than for elderly males and females. In CQ parameter, the elderly speakers (men and women) had significantly lower measurements than the young and middle-aged speakers.

*Conclusions:* The results of the present study demonstrated that, compared with young and middle-aged adults, elderly speakers had significantly different (usually poorer) vocal output on all of the selected acoustic parameters of voice. As the elderly population in Iran and the world continues to increase rapidly, studies of this kind are needed for researchers, educators, and practitioners to better understand the effects of aging on all aspects of human speech-language communication.

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### **Vibratory and Perceptual Measurement of Resonant Voice**

**Introduction:** Resonant voice is a commonly used vocal facilitative technique for treating individuals with phonotraumatic injuries. Traditionally, auditory perceptual evaluation is used to judge the degree of resonance during resonant voice production. The present study investigated whether there existed a correlation between auditory perceptual rating of resonant voice and the physical vibration in the facial bone. It also compared the magnitude of facial bone vibration in three types of voice production (resonant versus non-resonant versus strained voices).

**Method:** Thirty-six vocally healthy individuals were given a session of resonant voice training. Piezoelectric accelerometers were used to measure the vibrations over the nasal bridge and in the perilaryngeal area during resonant voice production. Seventy-two sounds (/ma/) under resonant voice condition by these speakers were selected and rated by two experienced speech pathologists to evaluate the amount of phonatory resonance using an 11-point equal appearing interval scale. The magnitude of facial bone vibration among the three voice types was compared as well.

**Results:** Results indicated significant moderate correlation between the nasal bone vibration and the auditory perceptual rating of phonatory resonance (Spearman  $\rho=0.6$ ,  $p<0.0001$ ). Compare to the non-resonant and strained voice, resonant voice has a significant increase ( $p<0.05$ ) in the magnitude of facial bone vibration.

**Discussion:** These results suggested that piezoelectric accelerometer can be used as a noninvasive tool to quantitatively and reliably measure the extent of bone vibration during resonant voice production. It is more useful than the auditory perceptual rating *per se* in determining the extent of resonance.

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## **Singing and Cystic Fibrosis: Private Voice Lessons as an Adjunct Airway Clearance Technique**

Relatively few studies have addressed the use of singing as a physical therapy, particularly in the treatment of pulmonary disease. Although anecdotal evidence exists to support the use of singing as an intervention in cystic fibrosis (CF), no studies have investigated the efficacy of voice lessons as an airway clearance technique for this disease.

Several types of physiotherapy are available for CF patients to clear the thickened respiratory tract secretions characteristic of the disease. These treatments are based on physiological principles such as cephalad airflow, the combination of expiratory airflow with high frequency oscillation at the chest wall or oral cavity, and repetitive cough. Diaphragmatic breathing, respiratory muscle training and voicing during therapy have also been shown to improve or maintain pulmonary function in CF patients. The physiology of airway clearance is similar to the physiology of singing, which involves controlled airflow resulting in pressure oscillations and vibration. Furthermore, singers build awareness of their bodies and learn to manage their breath. Singing is also a relatively inexpensive and enjoyable activity that requires little equipment or space. Singing should not replace medically recommended therapies, but it may be a viable adjunct therapy.

Research currently in progress at the adult CF clinic in Calgary, Alberta is addressing the effects of private voice lessons on pulmonary function and quality of life in adult CF patients. Additionally, the best practices for the use of singing lessons as an adjunct therapy will be investigated.

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## Hyoid and Laryngeal Position in People with Muscle Tension Dysphonia

Muscle tension dysphonia (MTD) is a common, non-organic voice disorder, yet its defining characteristics have been minimally objectively studied. Elevated position of the hyoid and larynx due to excessive activation of extrinsic laryngeal muscles is considered a hallmark characteristic of MTD but determination of these traits is through subjective palpation scales rather than objective measures. The purpose of this study was to determine whether radiographic measures of hyoid position, laryngeal position and hyolaryngeal space during phonation were different for people with primary muscle tension dysphonia as compared to control participants without voice disorders. Twenty participants, 10 with primary muscle tension dysphonia (MTD) and 10 without voice disorders who were age and gender-matched, were studied radiographically while producing phonation. Lateral x-ray images were obtained for each participant during three tasks: resting state, sustained phonation, and a swallow-hold maneuver. Vertical positions of the hyoid and larynx were measured on a Cartesian coordinate system, and were normalized to reflect change from rest during phonation. Results demonstrated that normalized, vertical hyoid and laryngeal positions during phonation were significantly higher for people with MTD than for control participants ( $P \leq .016$ ). Normalized hyolaryngeal space during phonation was equivalent between groups ( $P = .999$ ). Low to moderate, positive correlations were evidenced between the Total Score of a subjective laryngeal palpation scale and radiographic hyoid and laryngeal positions ( $\rho \leq 0.524$ ). There was no correlation, however, between the Laryngeal Position sub-score of this palpation scale and radiographic laryngeal position ( $\rho = 0.129$ ).

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### **Impact of Cheerleading on Acoustic Measures of Vocal Function: A Cross-Sectional Study**

Extensive research over the past 5-10 years has demonstrated that continued and habitual voice abuse or misuse can and often does lead to temporary or permanent changes in vocal function. The changes in vocal function are often a result of changes in tissue morphology and can be observed through direct visualization using videostroboscopy and through acoustic analysis of the voice under a controlled set of vocal function tasks. The current study (underway) will present acoustic analysis of both sustained /a/ and connected speech of voices of teenagers and young adults involved in cheerleading for athletic events. Three groups of subjects were identified: 1) Individuals who plan to participate in cheerleading for the first time but have not yet begun practices (typically in junior high); 2) Individuals who have participated in cheerleading for 2-3 consecutive years (typically juniors and seniors in high school); and 3) Individuals who have participated in cheerleading for 4-7 consecutive years (juniors and seniors in college). Control groups, comprised of students from each age group above who have not participated in cheerleading for any length of time and have not been involved in any other vocally abusive or damaging activities, will also be acoustically analyzed. The results of the acoustic analysis of the cheerleaders will be compared against results of other students in their same age group who are not cheerleaders. Measures of interest will be both formal and informal and will include maximum phonation times, s/z ratios, maximum available pitch and intensity ranges, mean  $F_0$  used in connected speaking task, mean intensity used in connected speaking task, habitual frequency and intensity ranges found in a connected speaking task, as well as the acoustic analysis parameters obtained through the KayPentax MDVP program, with particular interest in jitter, shimmer, DUV, DSH., DVB, NHR, VTI, SPI, and PPQ. Results: Length of time of exposure to the vocally damaging behaviors required in cheerleading is directly correlated with degree of abnormality and/or vocal pathology as measured by acoustic analysis. The damage caused by this activity is cumulative.

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## **Putting the Pieces Together: A Retrospective and Prospective Examination of Voice Therapy Adherence**

### Introduction:

The foundation of voice treatment is the seamless interaction between medical, surgical, and therapeutic endeavors. When medically prescribed voice therapy is not completed, the disruption leads to an unnecessary duration of treatment, repeated examinations without sufficient behavior change to effect improvement, and ultimately excess costs to third-party payors.

### Methods:

This paper reviews the literature published on voice therapy adherence to date in English-language, peer-reviewed journals. Fewer than 20 original articles were identified for review.

### Selected Results:

In an effort to document the problem of voice therapy adherence, Portone et al (2008) reported that 38% of voice therapy patients were lost to follow-up. Hapner et al (2009) found that 65% of patients who initiated voice therapy dropped out before completion. Sims et al (2010), found positive correlations between successful voice therapy completion and demographic variables; however, 44% of their study participants did not attend voice therapy after physician referral.

Portone-Maira et al (2010) examined temporal variables that may influence voice therapy attendance. The study found that a longer delay between referral and initiation of voice therapy was significantly related to dropout.

### Discussion:

The problem remains that although voice therapy is effective, the majority of patients do not complete treatment. Given reported dropout rates from 38-65%, it is obvious that clinicians must implement strategies to improve patient adherence to voice therapy.

Pilot data will be presented from a prospective, randomized, controlled trial of individual or group therapy examining the efficacy of the delivery model to improve adherence to therapy.

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### **VAPP Administered with Two Different Scales of Response**

**Purpose:** The purpose of this study was to compare two types of rating scales using the VAPP self-assessment questionnaire in order to check the influence of the different modalities on the results obtained by the same instrument. **Methods:** The population was composed of 32 individuals without vocal complaints, both genders, aged between 15 to 58 years. All individuals carried out a vocal self-assessment by means of the Voice Activity and Participation Profile questionnaire with two different rating scales – an 11-point numerical scale and a 10 cm long visual analogue scale. The questionnaires were randomly answered. The response time was recorded and there was an interval of two weeks between applications. Participants were asked about the difficulties encountered in the two rating scale versions and also to indicate their preference. **Results:** The mean VAPP scores were similar with both scales, except for the partial score - Activity Limitation Score and the aspect 5 - Effects on Emotion that had a higher mean score with the numerical scale ( $p = 0.008$ ), with no clinical impact. The order of responses did not affect the results obtained, except for the aspect 4 - Effects on Social Communication that presented lower scores with the visual analogue scale in the group of subjects that responded to the numeric scale first ( $p = 0.049$ ). Finally, the majority of the participants answered faster to the questionnaire with the numerical scale ( $p=0,003$ ). **Conclusion:** The scores produced by the two different rating scales were similar and the order of presentation of the questionnaires had little influence on results. Moreover, the questionnaire with the numeric scale takes less time to be answered, which may be useful for clinical application.

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### **Talkativeness and Vocal Loudness: Call Center Operation During Laboral and Extra-Laboral Situations**

*Purpose:* To investigate self-perceived talkativeness and vocal loudness of call center operators during laboral and extra-laboral situations and to compare them to vocal self-assessment and perceptual analysis.

*Methods:* Participants were 299 male and female call center operators working at either a receptive or active mode. Their average age was of 27.1 years. The procedures of the study consisted of the “Talkativeness and Vocal Loudness Test” that was administered in two different situations of communication - laboral and extra-laboral – as well as a vocal self-assessment and perceptual analysis of voice.

*Results:* Data showed that call center operators are usually young adults and that there are more women than men in this professional segment. Regarding talkativeness, younger operators refer having a high vocal demand both inside and outside of work when compared to the older ones. Regarding vocal loudness, again younger operators report speaking louder only during extra-laboral situations. Regarding gender, women talk more while working when compared to men. By comparing talkativeness and vocal loudness in laboral and extra-laboral situations, increased talkativeness and vocal loudness were observed in the laboral environment. No significant correlation was found between talkativeness, vocal loudness and self-assessment of voice.

*Conclusions:* Call center operator is a voice professional that reports speaking more and louder during work situations. Women talk more than men in any of the situations evaluated. There was no correlation between talkativeness, vocal loudness and self-assessment of voice.

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## **Perceptual Analysis of Adolescents Vocal Stability During Different Phonation Tasks**

**BACKGROUND:** quality and frequency variability of adolescents' voice, during puberty, in different phonation tasks.

**AIM:** to analyze the vocal stability of adolescents in three different phonation tasks using a voice perceptual analysis.

**METHOD:** participants were male students (n = 46 individuals), ranging in age from 13 to 15 years, from a public school in Campinas - SP. Voice samples were recorded using a digital recorder in three different tasks: speaking a sustained vowel /a/, counting from one to ten, and reading. Three voice specialists evaluated stability by means of voice perceptual analysis. For the voice samples that were considered unstable, the Analogical Visual Scale (AVS) of 10cm was used to estimate the instability level, where zero means absence of instability and ten refers to maximum instability.

**RESULTS:** 78.3% of the adolescents presented vocal instability when speaking the sustained vowel, varying from one to nine in the AVS. Only one adolescent presented unstable voice when counting numbers (level = 1). Vocal instability was not observed during reading for any of the participants. Vocal stability varied significantly among phonation tasks and adolescents showed greater instability during the sustained vowel ( $p < 0,0001$ ;  $g.l = 2$ ).

**CONCLUSION:** counting numbers and reading do not detect vocal instability; the production of a sustained vowel demonstrated to be a better task.

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### **Acoustic Analysis of Male Vocal Stability Before, During, and After Voice Mutation**

Abstract (250 words): During the process of human growth and development there are changes in voice patterns that start during puberty, when there is the passage of the child's voice to the adult voice, known as "voice mutation". This study analyzed, through the voice acoustic evaluation, the vocal stability patterns of boys before, during, and after mutation voice. Subjects included 100 boys, with an age range of 11 and 20 years, students from public schools in Macapá/Brazil. The assessment of pubertal development was based on the stages of genital development defined by Tanner: G1: Prepubertal, G2: Enlargement of scrotum and testes, G3: Enlargement of penis (length at first); further growth of testes, G4: Increased size of penis with growth in breadth and development of glans, and G5: Adult genitalia. For voice recording, subjects were instructed to utter a sustained vowel /  $\varepsilon$  / and count from 1 to 10. Most of the subjects studied were in G3 (47%) and G4 (34%). The voice fundamental frequency  $F_0$  during the sustained vowel /  $\varepsilon$  / had an average above 200 Hz for G1, G2, G3, and G4, with a frequency decrease only in G5. Shimmer and the deviation phonatory diagram were altered in all stages. In the automatic speech, the  $F_0$  decreased in the pre teen to adulthood. Semitones were above normal limits. The studied group does not present vocal maturity development. Therefore, it can be inferred that the voice maturation does not occur in parallel with the human development.

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## The Sequel to Group Voice Therapy: The Role of Group Climate

*Background:* Group therapy is a widely used service delivery model in speech pathology. Our pilot study showed that group voice therapy is effective and its effectiveness appears to be associated with positive group climate. This current study aimed to substantiate the effectiveness of group voice therapy by using a larger cohort of patients.

*Methodology:* Thirty-five participants with hyperfunctional dysphonia attended six sessions of group voice therapy. Treatment comprised of both direct and indirect voice therapy. Direct therapy utilized the principles of resonant voice therapy. Therapy techniques were introduced and practiced in a group format. To allow for peer modeling and generalization, participants were encouraged to practice in small groups. Outcome measures were taken using a voice-related quality-of-life and treatment completion rate. The Group Climate Questionnaire was used to measure the underlying process of group therapy.

*Results:* Results indicated statistically significant improvement in the participants' overall voice-related quality-of-life ( $p < 0.001$ ) with an effect size of 0.5. This study achieved an 89% completion rate and 86% of the participants attended more than half of the therapy sessions during the program. The group climate questionnaire indicated that the treatment cohort is classified as "engaging" rather than "avoiding" and "conflicting", which is known to be associated with positive treatment outcome.

*Conclusion:* Group therapy possesses many advantages over individual-based therapy from the psychosocial, clinical, health resources allocation and motor learning perspective. This study further confirms that group therapy is an effective and viable service delivery model for voice therapy.

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## URICA-V Questionnaire to Identify Stages of Adherence to Voice Treatment

*PURPOSE:* To adapt the URICA questionnaire to the assessment of motivational stages of patients undergoing voice treatment and to check the association among the stages and age, type of dysphonia, education, occupation and number of therapy sessions.

*METHODS:* Cross-sectional study, with 66 consecutive dysphonic patients, 58 women and 8 men, aged between 18 and 68 years, in outpatient care in two federal universities. The URICA general questionnaire was adapted to the voice area – URICA-V, with the consent of the original authors, based on specific situations related to vocal behaviour. URICA-V has 32 items, 8 from each motivational stage: pre-contemplation, contemplation, action and maintenance. *RESULTS:* The majority of patients (38; 57,6%) were at the contemplation stage and only 8 of them (12,1%) were at the action stage, ideal for therapy. There was no association between the adherence stages and age, the type of dysphonia, educational level and number of therapy sessions. The variable occupation was significantly associated with the action stage URICA -V ( $p < 0.001$ ). URICA-V is a simple tool that requires less than 5 minutes to be answered. The information yielded helps the clinician to verify if the patient is ready for changing. Pre-contemplation and contemplation results indicate the need of a specific approach to improve awareness before undergoing an active rehabilitation program.

*CONCLUSION:* URICA-V showed that the majority of dysphonic patients undergoing treatment are still in the contemplation stage, which can restrict the results of therapy. The use of this questionnaire may improve outcome results.

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### **The Accumulated Vocal Dose of Female Singers in Classical and Musical Theater Styles**

Vocal dosimetry is an emerging tool in singing and voice science. While acoustic, perceptual, and stylistic differences are clear between classical and musical theater singing, a comparison of the typical vocal dose associated with each style has not been attempted. Eight female singers trained in either classical or musical theater style (16 singers total) sang selections from the standard repertoire in their style for 30 minutes with piano accompaniment in a average size classroom while wearing a vocal dosimeter (Ambulatory Phonation Monitor; KayPENTAX). The pieces were familiar to the singers within each style and were chosen to allow for nearly continuous singing for the 30 minute period (minimum of piano introductions or interludes). The APM data was compared specifically regarding percent phonation time, phonation cycle dose, and vocal fold distance dose, both within and across singing styles. Preliminary data analysis has shown large differences in vocal dose for the two singing styles (effect size measured with Cohen's *d*). Musical theater singers tended to have higher average intensity and accumulated distance dose, while classical singers tended to have higher average fundamental frequency and accumulated cycle dose. In addition, classical singers tended to have more variability in both intensity and fundamental frequency than musical theater singers. Implications for future research into the quantifying vocal doses across singing styles and assessing vocal injury risk will be discussed.

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## Fundamental Frequency Variability in Parkinson's Disease

### *Objectives/Hypothesis*

In Parkinson's Disease (PD), speech changes, such as decreased variation in pitch and loudness, can occur among other symptoms. However, quantitative vocal changes are not well documented. This experiment investigated differences in the variability of fundamental frequency in PD patients both ON and OFF levodopa medication versus healthy controls.

*StudyDesign:* Case control

### *Methods*

32 subjects (23 male, 9 female) and age and sex-matched controls were recorded during a reading task. PD patients were tested both OFF and ON medication. The fundamental frequency standard deviation (F0SD) was determined for the entire reading passage as well as for the first and last sentences of the passage.

### *Results*

A two-way analysis of variance indicated that although female speakers were found to have higher F0SD than males, that there was no interaction between group (PD ON, PD OFF, CONTROL) and sex. Post hoc tests indicated that F0SD was significantly increased in controls relative to both PD groups and PD patients showed significantly higher F0SD ON medication relative to OFF. No significant effect of group was seen in the change in F0SD from the beginning to the end of the reading passage.

### *Conclusions*

F0SD is reduced in PD and affected by medication status. Although recent work has indicated that F0SD decreases over a reading passage in PD, we saw no significant differences between PD patients and controls in the change in F0SD. Therefore, F0SD changes may not be indicative of PD and may be dependent on the linguistic characteristics of the stimuli.

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## Impact of Clinical Context in Characterization of Severity of Vocal Deviation

The clinical context of the evaluation may influence the final outcome of the perceptual analysis.

*Objective:* We verify if the clinical context interferes in the assessment of vocal deviation, considering the overall degree of severity.

*Methods:* We selected 22 voice recordings of 12 women and 10 men diagnosed with organic or functional dysphonia, aged between 25 and 75 years old, pre-and post-therapy. The vocal sample was analyzed by two SLP voice specialists, one of which (SLP-1) was the patients' therapist and conducted a contextualized clinical assessment. On the other hand, the second voice specialist (SLP-2), did not know any of the patients and conducted the assessment only by listening to the recordings. The speech material used was the sustained vowel /□/. The overall degree of vocal deviation should be marked on a visual analog scale of 100mm.

*Results:* Being aware of patients' clinical aspects has influenced the APA in both pre- and post-therapy. The SLP-1 produced an average of 53.8 on pre-therapy evaluation (range 17 to 100), while the SLP-2 produced an average of 62.8 (range 32 to 100). In the post-therapy assessments, the average was 22.8 for SLP-1 (range 7 to 47), and 51.9 for SLP-2 (range 28 to 92). The SLP-2, without access to information, considered larger deviations in both moments, which probably indicates that contextualized listening influences the vocal assessment, especially post-therapy.

*Conclusions:* The listening situation, involving clinical context awareness or not, has a direct impact on the perception of a voice disorder, even in experienced clinicians.

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## **The Use of an Inspiratory Muscle Strength Training Program for Reducing Dyspnea in Patients with Upper Airway Obstruction**

*Objectives:* The purpose of this randomized-control trial is to examine the use of an inspiratory muscle strength training program on the reduction of dyspnea in patients with upper airway obstruction (UAO). The training program is expected to increase the efficiency and reduce the fatigue of inspiratory muscles during speech and exercise tasks.

*Methods:* Participants between the ages of 10 and 35 years with a diagnosis of UAO including subglottic stenosis, bilateral vocal fold paralysis, and laryngeal scarring are being recruited. Experimental participants are provided with a hand-held pressure-threshold inspiratory trainer to complete a 4-week home-based training program. Sham participants receive a trainer set at a level not expected to increase strength. Pre- and post-training measures include maximum inspiratory pressure (MIP), which is used as an indirect measure of inspiratory muscle strength and perception of dyspnea during reading and a 12-minute walking task. Perception of dyspnea is evaluated using a 10-point Borg scale.

*Results/Conclusions:* Results of this training program will be analyzed by diagnosis. Analysis of four participants, with a diagnosis of subglottic stenosis who have completed the experimental training program, reveals a mean increase in MIP of 67% following the training program. The perception of dyspnea during exercise decreased by 45%. Only minimal changes in dyspnea during speech have been observed, however, preliminary analysis of the recorded pre/post speech samples reveal that pause length during reading increased while the number of pauses decreased. This finding points to an increased efficiency of inspiratory muscles during speech production.

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## Coping Strategies in Teachers with Voice Complaint

**Purpose:** To understand the coping strategies used by teachers. **Methods:** 90 individuals, divided as follows: G1- 30 teachers with vocal complaints who sought voice treatment, G2 - 30 teachers with vocal complaints who have not sought for treatment, and G3 - 30 teachers without vocal complaint. **Procedures:** Voice Disability Coping Questionnaire-27 – VDCQ-27, Voice Signs and Symptoms Questionnaire, Voice Activity and Participation Profile – VAPP, and voice perceptual analysis. **Results:** G1 had higher VDCQ-27 scores (G1=45,4; G2=38,5 e G3=9,5;  $p=0.000$ ) and higher means of voice signs and symptoms (G1=8,6 G2= 6,6 e G3 2,0 symptoms;  $p<0.001$ ). The vocal complaint group (G1+G2) had voices with mild to moderate deviation, and the group without vocal complaint (G3) had normal voices (mean G1=49,9; G2=43,7; and G3=32,3;  $p<0.001$ ). The aspects that were correlated with VDCQ-27 in the three groups were: degree of vocal deviation, VAPP total score, VAPP partial scores of self-perceived severity of voice problem, effect on daily communication, effect on emotion, and participation restriction for G1; VAPP total score and partial score of effect on daily communication for G2; and all VAPP scores for G3. No correlation was found between voice signs and symptoms and coping. **Conclusion:** G1 has greater use of coping strategies. Signs and symptoms played an important role regarding seeking treatment, but had no influence in coping. The higher the limitations and restrictions on participation in vocal activities perceived, the greater the coping.

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### **House Calls: Taking Vocal Health Education to the Cast of a Broadway Touring Company**

Singers on a Broadway tour are particularly susceptible to voice problems due to a number of factors, which may include suboptimal vocal hygiene, incomplete education regarding vocal pacing and exercise, and inadequate management of medical conditions that contribute to voice problems (allergies, reflux, etc.)

This is a pilot study examining the knowledge singers on a Broadway tour possess regarding vocal health, including basic vocal hygiene, medical problems that can affect the voice, vocal pacing, and principles of vocal efficiency and vocal fitness. The project will also provide a model for delivering essential information for vocal health and wellness to performers in a high-risk group for vocal injury.

The entire cast of the North American tour of *The Lion King* (50-60 performers) will participate in a two-day vocal health and wellness workshop given by clinical staff from Duke Voice Care Center, including a laryngologist and singing voice specialist SLP. The clinical staff are contracted to provide this training and will travel to meet the company during their 2011-2012 tour.

Baseline knowledge of vocal health and self-perception of voice problems will be assessed through administration of an adapted version of the *Voice Knowledge Questionnaire*, the *VHI-10* and *SVHI-10*.

Results of the baseline surveys and content of the vocal health workshop will be presented at the Voice Foundation Symposium. Follow-up studies will assess whether the education and training resulted in changes in behavior leading to improved vocal health, as well as changes in self-perception of voice problems.

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### **Perturbation Measures of Glottal Area Waveform in Fatigued Voices in High-speed Imaging**

Vocal fatigue is perceived as vocal tiredness resulting after voice overuse, misuse or abuse. Vocal fatigue often appears along with a combination of other symptoms that include tightness in the throat and chest, dysphonia, worse voice quality, and difficulty to talk loudly. It's unclear whether vocal fatigue is accompanied by any physiological changes of vocal folds.

High-speed laryngoscopic imaging technique can examine complete cycle-by-cycle vocal vibration patterns. This study examined the vocal fold vibration pattern of fatigued voice using high speed laryngoscopic imaging technique. Twenty participants aged from 18 to 23 years with normal voice were recruited to participate in an extended singing task. Vocal fatigue was induced through prolonged singing. High speed laryngoscopic imaging was taken before and after the singing task. Images of /i/ phonation were analyzed using the High Speed Video Processing (HSVP) program, which was used to analyze high-speed laryngoscopic images using quantitative measures of the glottal area.

Significant changes were found in the posterior glottal length ratio index and glottal length to width ratio index following vocal fatigue. This means the glottis will be narrower following fatigue. The perturbation of glottal area waveform (shimmer area, jitter area, harmonic-to-noise ratio area) in fatigued voices have also been measured and show moderate change. [Supported in part by HKRGC-GRF#757811]

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## **Effects of Prolonged Loud Reading and Vocal Recovery on Selected Measures of Acoustic and Aerodynamic Parameters**

### *Aim of the study:*

The aim of the present study was to investigate the effects of induced vocal loading on selected acoustic and aerodynamic parameters of voice in adult males and females. The secondary aim of the study was to document the vocal recovery pattern after vocal loading task (prolonged loud reading).

### *Method*

*Participants:* The study was conducted on 20 adult individuals, consisted of 10 females and 10 males. They were within the age range of 18 years to 28 years. The participants were ruled out for any speech, language and hearing related problems and any history of smoking, laryngeal pathology, intubation, neurological disorders, systemic illness, and surgery/accident/trauma, sustained (prolonged use) medications for any medical conditions. All the participants had perceptually normal voice in terms of pitch, loudness, and quality and a loudness dynamic range of 40- 80 dB SPL.

*Results:* Acoustic parameters were compared across the subjects at different conditions of pre and post experiments. Average fundamental frequency (F0), and Noise to Harmonics Ratio (NHR) were increased from pre-task (PrT) to immediate post recordings (PoT<sub>0</sub>), further these parameters decreased and reached near the baseline values after 20 minutes of voice rest (PoT<sub>20</sub>). After 24 hours of voice rest (PoT<sub>24Hrs</sub>), F0 and NHR values were reduced further which was similar to baseline values. However, other acoustic parameters did not exhibit similar trends that shown larger variations across subjects and across different conditions. Forced vital capacity showed increased values immediately after the loading task (PoT<sub>0</sub>) and after 20 minutes of voice rest (PoT<sub>20</sub>). After 24 hours of voice rest (PoT<sub>24Hrs</sub>), FVC values were decreased and it was as similar as the baseline values.

*Conclusion:* The acoustic voice parameters like F0 and NHR are sensitive measures to detect and document the subtle changes which are caused due to loud reading. Other acoustic parameters and FVC values revealed variable trend due to loading. Further, the study revealed that the selected acoustic and FVC values restored back to baseline level after 24 hours of voice rest. Larger number of samples/observations is warranted to conclude and generalize the results.

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**The Use of Evidence Based Practice to Manage Functional Voice Disorders (With or Without Organic Change) In Adults: A National Survey of Speech Language Pathologists.**

The purpose of this study was to determine if practicing Speech Language Pathologists (SLPs) in Australia are currently using evidence based practice (EBP) in the management choices and selection of voice therapy techniques and/or programs to treat functional voice disorders (FVD) in adults. The sources used by SLPs to inform and guide their clinical decisions when managing FVD in adults were also explored. It is hypothesised that in the presence of high levels of evidence, SLPs in Australia will engage in EBP to provide efficient and efficacious health care to their clients.

Fifty eight SLPs completed a 26-item web-based survey. Data was analysed using frequency counts, content analyses, and comparative analyses. Participants reported using a range of management options and voice therapy techniques and programs. A combination of indirect and direct voice therapy techniques and/or programs was the most frequently used management option, with elimination of glottal attack, diaphragmatic breathing, and use of hum and nasal consonants being the voice therapy techniques most frequently used. Fifty eight per cent of SLPs also reported that they would treat functional voice disorders *with* organic change differently to how they would treat functional voice disorders *without* organic change. When selecting voice therapy techniques, the majority of SLPs reported that they relied on workshops and professional development events to guide their clinical decisions. Implications regarding SLPs management of FVDs in adults and their application of EBP are discussed.

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### **The Effect of Experience on Classification of Voice Quality**

*Objectives/Hypothesis:* The purpose of this study was to compare the agreement among several groups of listeners with different types of experience in regard to classifying voice quality.

*Study Design:* This is a retrospective cross-sectional quasi-experimental design.

*Method:* This study compared three groups: speech-language pathologists who specialize in voice, singing voice teachers, and inexperienced listeners. All groups were asked to classify voice samples as breathy, rough, or normal.

*Results:* Results show a significant difference across all groups with speech-language pathologists demonstrating a substantial interrater agreement,  $\kappa=.67$ ,  $z=103.07$  ( $p<0.01$ ), singing voice teachers demonstrating a moderate interrater agreement,  $\kappa=0.53$ ,  $z=79.10$  ( $p<0.01$ ), and inexperienced listeners demonstrating a fair interrater agreement,  $\kappa=0.24$ ,  $z=35.82$  ( $p<0.01$ ).

*Conclusions:* Experienced listeners demonstrated a higher interrater agreement as compared to inexperienced listeners, with speech-language pathologists demonstrating a superior agreement as compared to all groups.

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### Voice Disorder in Friedreich Ataxia

Friedreich Ataxia (FRDA) is a spinocerebellar neurodegenerative disorder and the most common hereditary ataxia syndrome. Its neuropathology extends beyond the cerebellum to include cortical and subcortical structures, leading to both dysarthria and dysphonia. Little evidence exists on the voice quality of individuals with FRDA. Therefore, this study aimed to document the voice profiles of FRDA; to examine the relationship between disease severity, genetic markers and disease duration and voice quality; and to investigate further the notion of subgroups within the population.

Voice samples were acquired from 32 individuals diagnosed with FRDA and 20 healthy age and sex matched controls. Samples were examined acoustically (Multi Dimensional Voice Program (MDVP) and SpeechTool), and perceptually (CAPE-V). 5 out of 11 acoustic parameters were found to be significantly different between FRDA control subjects. These included Standard Deviation of Fundamental Frequency, Jitter, Shimmer, Noise to Harmonic Ratio and Soft Phonation Index. These were correlated with perceptual features. Cluster analyses revealed 2 subgroups within the cohort. The first presented with values similar to controls (N=27), and the second subgroup had values more deviant from controls. The existence of subgroups within the clinical profile of FRDA is line with perceptual studies examining speech deficits in FRDA. Implications for the neurological aetiology of FRDA in regards to speech and voice are discussed.

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### Acoustic Comparison of Vowel Sounds

This study consisted of an experiment comparing acoustic characteristics of vowel production. All data was collected in a quiet environment using the Computerized Speech Lab (CSL), a computer-based system designed to measure characteristics of voice. A systematic methodology of data collection was organized, in an effort to establish a research protocol based on relevant literature, involving (a) keeping constant  $F_0$  and intensity, (b) positioning of participants and recording equipment, and (c) analysis of data. Results revealed that vowel sounds had a significant effect on shimmer, NHR, and VIT. Furthermore, speech sounds classified as back vowels exhibited less perturbation and noise in the acoustic signal: the high-back vowels [u] and [ʊ], and the mid-back vowels [o], and [ɔ], demonstrated most of the statically significant reduced values of shimmer, NHR, and VTI among the 12 vowels compared. Further comparisons among front and back vowels grouped in clusters associated to more and less variability lead to statistically significant differences. Overall, speech sounds classified as back vowels exhibited less variability and noise. Based on the results of this study, back vowels of the English language should be used in voice acoustic tasks, given the higher stability of their acoustic signal, as compared to other vowels tested. Additional tests were applied to a tentative examination of gender related differences, indicating a significant effect of NHR.

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## **Inexperienced Listener Impressions of Speakers with Spasmodic Dysphonia**

*Objectives/Hypothesis:* Adductor spasmodic dysphonia (ADSD) is characterized by uncontrolled spasms of intrinsic laryngeal muscles. Patients with ADSD report difficulties related to employment and reduced psychosocial well-being. No study has investigated how the speech produced by ADSD patients may also influence listeners' attitudes about these speakers. The objectives of this study are to determine 1) if listeners' attitudes toward speakers with ADSD differ from attitudes towards healthy control speakers; and 2) whether listeners' attitudes towards speakers with ADSD are related to perceived strain or patient-rated vocal effort and voice-related quality of life.

*Study Desgn: Experimental/Correlational*

*Methods:* Twenty speakers with ADSD and 20 healthy age- and sex-matched controls provided speech recordings. ADSD speakers also completed the VHI and self-rated vocal effort. 40 inexperienced listeners will make judgments of speech samples for strain using visual analog scales and provide judgments of age, employability, confidence, and emotional stability using semantic differential scales.

*Results:* Group means of listeners' judgments will be calculated across conditions. Multiple t-tests (Bonferroni corrections) will determine whether differences exist between control and ADSD speakers. *Hypothesis:* Listeners will judge those with ADSD more negatively and with increased strain. Additional linear regression analyses will be performed to determine if less favorable ratings made by listeners correlate with strain, patient-rated effort, and VHI scores

*Conclusions:* Results will reveal whether inexperienced listeners' attitudes of those with ADSD differ from severity of speech and whether oft-reported psychosocial and employment difficulties relate to negative attitudes. Implications for counselling and education will be discussed.

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## **Immediate Effect of Transcutaneous Electrical Nerve Stimulation (TENS) in Individuals without Vocal Complaints – a Pilot Study**

*Purpose:* to evaluate the immediate effect of low frequency TENS on cervical and laryngeal muscles, and on voice quality of individuals without vocal complaints.

*Methods:* Twenty-five male and female individuals aged between 18 and 45 years, with normal voices and no vocal complaints participated. After signing the informed consent, the individuals used visual analog scales to report musculoskeletal pain on the cervical and laryngeal areas and their voices were recorded. These procedures were performed before and after the appliance of TENS and the results were compared. The perceptual assessment included the overall vocal impact, roughness, breathiness, strain, instability, resonance, and vocal and articulatory clarity. For the procedure, the individuals remained lying in supine position for 20 minutes, with bilateral electrodes on the superior fibers of the trapezius muscle and on the submandibular area, with 200  $\mu$ s phase duration, frequency of 10 Hz and intensity according to the motor threshold. The data was analyzed using the paired t-test.

*Results:* We found improvement of pain on the neck area ( $p=0.009$ ), on the overall impact of the voice (60.71%), strain (53.57%), instability (42.85%), articulation clarity (35.71%) and vocal clarity (32.14%). The individuals reported: clearer voice (76%); relaxed larynx (60%); better articulation and speaking with ease (56.6%).

*Conclusion:* The use of low frequency TENS caused positive immediate changes of the cervical and laryngeal muscles, with significant decrease of pain. The quality of voice may or may not suffer positive changes, which are more evidenced on its overall impact, strain, and vocal and articulatory clarity.

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### **Nonlinear Analysis Pre and Post Vocal Rehabilitation**

Voice problems in teachers are usually treated with vocal rehabilitation - VR. Traditional acoustical analysis has shown some limitations for identifying vocal changes with voice therapy. The Vocal Dynamic Visual Pattern analysis - VDVP was developed from nonlinear methods as an alternative approach to assess vocal function. This technique manages to evaluate phonation with aperiodic segments and can be seen as a promising tool for analyzing voices in rehabilitation process. The goal of the present study is compare teachers' voices pre and post-VR (8 sessions) using nonlinear dynamical tools. Twenty-five teachers with behavioral dysphonia, mean age of 37 years old (25 to 55 year old), sought voice treatment. All patients were submitted to a routine assessment, including perceptual and traditional acoustic evaluation, pre and post-VR. Moreover, a sustained vowel sample (/ae/) was recorded to be submitted to a qualitative and quantitative nonlinear analysis based on phase-space reconstruction and Poincaré section techniques. For qualitative analysis 3 main characteristics were measured: loops configuration, trajectories regularity and trajectories convergence; for quantitative measures an algorithm based on Pointcaré Section was performed. The main results were: difference for loops configuration ( $p < 0.029$ ), regularity ( $p < 0.007$ ) and trajectories convergence ( $p < 0.001$ ); moreover, quantitative analysis has also shown significant differences pre and pos-VR ( $p < 0.001$ ) for both measures of dispersion. In conclusion, the VDVP quantitative and qualitative analysis proved to be a useful tool for clinical evaluation pre and pos-vocal rehabilitation.

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### **Intrasubject Variability on the Phonatory Aerodynamic System (PAS)**

The purpose of this study was to examine the degree of intrasubject reliability of commonly used aerodynamic measurements obtained using the Phonatory Aerodynamic System (PAS 6600, KayPentax) in normal voice young adults. Acceptable test-retest reliability is essential if instrumental measures are to be used as effective indices of voice disorder progression and treatment change

Participants were 64 healthy adults (33 males, 31 females) with perceptually normal voice quality. They were tested using the PAS on two separate days with approximately one week between each session at approximately the same time of day. The Vital Capacity, Maximum Sustained Phonation, Comfortable Sustained Phonation, and Voicing Efficiency protocols were conducted, with order of task randomized. Instructions for protocols were from the PAS Instruction Manual and three trials of each task were elicited. All data were saved using the PAS software and measured at a later time.

Results indicated no significant difference between testing sessions on all selected PAS measurements. In addition, strong positive correlations between testing sessions 1 and 2 were observed for Vital Capacity ( $r = .87$ ), Maximum Sustained Phonation ( $r = .85$ ), Resistance ( $r = .87$ ), Peak Pressure ( $r = .78$ ), and Mean Expiratory Flow ( $r = .77$ ) Results indicate that aerodynamic measurements are highly reliable within normal speakers when elicited using comfortable pitch and loudness and, when procedures are standardized, within subject differences in PAS measures over time may be attributed primarily to changes in respiratory/phonatory function.

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## **Relationship of Water Intake with Laryngeal Sensation, Coughing, Throat Clearing and Mucus**

SLPs and ENTs frequently suggest that patients increase their water intake. It is believed hydration is important for vocal health. The purpose of this study was to ascertain whether frequency of coughing, throat clearing and laryngeal sensation is different between persons with and without voice disorders based on their reported fluid intake and hydration status. Additionally, this study examined if water intake impacts mucus aggregation in persons with and without voice disorders.

Forty-six persons, 22 with and 24 without voice disorders, completed a questionnaire about their water intake, fluid intake, throat clearing and coughing habits. Participants underwent stroboscopy which was rated for features of mucus aggregation (mucus type, pooling, thickness, and location). This data was evaluated against measures for systemic hydration and patient reports of laryngeal sensation.

Reported water intake, but not fluid intake, was significantly related to fewer reports of irritating laryngeal sensation, but not coughing or throat clearing, in persons with voice disorders. When assessing patients and controls together, people who drank less than 8 cups of water per day had more severe mucus pooling than their counterparts ( $p=.00023$ ) as well as more type 2 mucus ( $p=0.031$ ).

These findings provide preliminary information regarding the relationship of water intake on coughing, throat clearing, laryngeal sensation, and mucus aggregation. These findings also provide evidence that amount of water intake does impact mucus presence and type. Further understanding of this relationship would help elucidate the evidence for recommending that patients who chronically throat clear and cough increase their water intake.

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**The Impact of Situation-Associated Reactions, Coping Behaviors and Attitudes of Individuals with SD on Clinical Outcomes**

The impact of voice difficulty on emotion, attitude, coping behaviors and quality of life has not been fully understood for individuals with spasmodic dysphonia (SD). Until now, voice disorders have been assessed and dealt with in a rather mono-dimensional way, although clinical experience has made it clear that individuals with SD suffer from more than just a speech/voice problem. The purpose of this study is to assess the behaviors of avoidance and escape, speech-associated attitude, and emotional reaction and speech disruption related to particular situations among individuals with SD. In order to determine whether or not individuals with SD score differently compared to control subjects and people who stutter (see previous data), an adaptation of the existing Behavior Assessment Battery (BAB-Voice; Brutton & Vanryckeghem, 2010) and the Erickson S-24 Communication Attitude Test was administered to 100 participants, ages 18-80 (males and females) with SD. These questionnaires explore an individual's speech associated attitude, reactions to speech situations and speech-related behaviors by asking each adult to circle "true or false", to check or rank his/her reaction to speech situations on a 5-point scale and to indicate the coping responses, if any, that the respondent might use to cope with his or her voice problem. Administration of the different tests was randomized. The data from the responses on these self-report tests will aid SLP's and other health care professionals in choosing the most successful approach to therapy. Discussion will focus on tailoring treatment option to patient specific needs, emotions, beliefs and coping strategies.

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### **Perceptive and Acoustic Vocal Parameters in Elderly People with Professional Voice Use**

AIM: To verify if using one's voice professionally throughout life interferes in perceptive and acoustic vocal parameters common to aging. METHOD: Questionnaire: referring to identification, professional voice usage, daily living, social life and general health. Elderly women between the ages of 60 to 81 were selected. Acoustic analysis: PRAAT5.3, considering the emission of sustained /a/, from which were extracted the fundamental frequency, intensity, vocal extension, jitter and shimmer. Perceptive-auditory analysis: GIRBAS scale and voice modulation and articulation. The reliability test for inter-evaluator was performed. The resulting data was statistically analyzed and compared (Analysis of Covariance - ANCOVA and Kruskal-Wallis parameter tests). RESULTS: 44 subjects was distributed in: AI – elderly women that currently use their voices professionally (a minimum of 20 hours a week for 20 years or more); AII – elderly women that used their voice for 20 years and interrupted the professional use of voice at least 10 years ago; B - elderly women without professional use of voice. The subjects demonstrated that they had similar characteristics regarding age, number of working hours, time of professional use of voice, changes in voice associated to professional use (AI/AII); inadequate voice habits such as smoking; complaints about current voice and general health. There are statistical difference related to voice care; voice use when practicing physical activities and speaking intently, maximum frequency variable in glissando and asthenia. CONCLUSION: Elderly women that use their voices professionally and interrupt vocal use presented greater care of their voices, as well as presented better acoustic parameters.

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### **The Effects of Speech Task on Fundamental Frequency in Cantonese Children**

The present study examined the effects of speech task on the fundamental frequency (F0) in a group of vocally healthy children. The study also compared the reliability of different speech tasks for eliciting F0. Fifty-six vocally healthy children (31 boys and 25 girls) aged between 7.0 and 10.11 years participated in this study. All children were native speakers of Cantonese. Each child was invited to a quiet room in their school for a recording session, which comprised of three speech tasks including sustained vowel /a/ prolongation, reading aloud a sentence, and reading aloud a passage. The F0 elicited from the three speech tasks were analyzed using Praat. Two types of reliability including between-trial and between-day reliability were also compared across speech tasks. Results revealed significant difference in F0 between the three speech tasks ( $p=0.01$ ). Post hoc comparisons revealed that the mean F0 value elicited from sustained vowel prolongation task was significantly higher ( $p<0.05$ ) than that elicited from the passage task. Passage reading task yielded the highest intra-class correlation coefficient values for both between-trial and between-day reliability. The results provide some empirical data for standardizing voice assessment protocol for school-age children. The findings support the use of connected speech stimulus, preferably at passage level, for acoustic measurement of F0 in children.

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### **The Effects of Tones on Vocal Attack Time in Cantonese Speakers**

Vocal attack time (VAT) is the time lag between the growth of the sound pressure and the beginning of physical contact of the vocal folds. It can be derived by a cross-correlation of short-time amplitude changes occurring in the sound pressure and the electroglottographic signals. Cantonese is a tone language in which the pitch patterns (tone) determines the lexical meaning of the syllable. Physiologically, the vocal folds need to be set up differently at the pre-phonatory stage in order to produce different tones. Therefore, one would hypothesize that the VAT values may vary as a function of which tone is to be produced.

The present study investigated the effects of tones on VAT in Cantonese speakers. Fifty-nine native Cantonese speakers (28 males and 31 females) participated. They were asked to read aloud 12 Cantonese disyllabic words comprising homophone pairs of the six Cantonese tones. Results revealed significant differences in VAT values between the two tone-categories (“level” and “contour”) in Cantonese, with the mean VAT values of the three level tones significantly smaller than those of the three contour tones. Among the three level tones, the mean VAT values of tone 1 (highest pitch level) was significantly smaller than tone 3 and 6. Results also revealed a gender difference in VAT values, with the mean VAT significantly smaller in females than in males. In addition to offering insight into the physiology of vocal fold behavior, the findings provide empirical support that norms collected from non-tone European languages may not be directly applied to tone languages.

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### **Does the Use of MP-4 Players Increase Adherence to Voice Therapy in Children?**

**BACKGROUND:** Voice therapy is frequently recommended for children with dysphonia. Home exercises are generally recommended to supplement weekly therapy sessions. Getting children to adhere to daily practice is often challenging. Like other behavioral therapies, successful outcomes are dependent on adherence to home practice. Use of computer technology could enhance motivation thereby improving outcomes.

**OBJECTIVES/ HYPOTHESIS:** The objective of this study is to determine whether the use of a video model recorded on a hand-held MP-4 player (similar to an iPod Nano) would increase practice frequency in children.

**STUDY DESIGN:** Prospective, randomized, alternating treatments design (“ABAB” vs “BABA”).

**METHODS:** 20 children, age 6-17, diagnosed with dysphonia and referred for voice therapy, were consented for and included in the study. Two treatment approaches were alternated on a weekly basis: SOC (standard of care) voice therapy, in which patients were provided with written instructions for home practice, and SOC+VM (standard of care voice therapy + video modeling), in which video models on MP4 players were provided in addition to standard therapy. At the beginning of each session, practice frequency and patient and parent perception of amount of time using target that week were recorded.

**RESULTS:** Preliminary data analyses suggest a trend toward increased practice frequency in the video modeling condition.

**CONCLUSION:** Video modeling on an MP-4 player or similar device increased practice frequency in children enrolled in voice therapy during the weeks that they were using the device.

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### **One-Time Estimates vs. Three-Week Voice Log Estimates of Voicing Behaviors in Singers and Non-Singers**

This study compared the estimates of voice-related behaviors offered in a clinical history questionnaire as compared to estimates derived from three weeks of daily voice logging. Twenty-four college-age non-singers have completed the study to date; 20 college-aged singers-in-training are being gathered at this time for comparative purposes. All participants complete a two page history questionnaire that asks about total daily minutes of talking and singing, fluid intake, reflux-related symptoms and behaviors, etc. A daily voice log is then kept for three weeks that asks them to record data on these same parameters. Estimates of average daily values are derived from the three week log to compare to the initial estimates they provided in the clinic. Results to date for the non-singers indicate a statistically significant over-estimation in the in-clinic reporting of fluid in-take, hours of sleep, and minutes of exercise compared to the estimate derived from the 3-week log. Respondants significantly underestimated their self-rated stress level and minutes of talking in the in-clinic reporting. These early results suggest that college-age non-singers may provide less accurate (or at least different) reporting of voice behaviors when using a one-time questionnaire compared to what they offer when reflecting and recording on these same behaviors on a daily basis over several weeks. Implications for voice history gathering in a clinical setting will be discussed. Comparisons between singers and non-singers will also be explored once data from singers are available.

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### **Inter-judge Reliability in Identification of Variants of Spasmodic Dysphonia.**

Persons with adductor spasmodic dysphonia (ADSD) exhibit a wide variety of voice qualities. Bastian has identified several variants of ADSD, including: classic ADSD (episodic strain), tonic ADSD (sustained strain), stage whisper ADSD (strained devoicing), mixed SD, and ADSD with co-occurring tremor. It may be that these variants reflect underlying differences in physiology and may respond differently to treatment.

The purpose of this study is to determine how reliably speech pathologists are able to distinguish between these variants.

Four speech-language pathologists were asked to rate 16 samples obtained from persons with a diagnosis of SD. Prior to rating the samples, the judges were provided with written descriptions of each variant. They were asked to (a) provide a brief written description of the voice quality observed during sustained phonation, reading, and conversation, (b) circle voice qualities they heard from a list of common qualities associated with SD, (c) identify the variant of ADSD, (d) identify any co-occurring tremor, and (f) identify the overall severity of the voice disorder (0 = normal , 5 = severe). To allow us to determine intra-judge reliability, judges re-rated half of the samples 2 weeks after the initial ratings.

The data was analyzed to determine the level of agreement among the judges in identification of (a) the variant (b) the presence of a co-occurring tremor, and (c) the overall severity rating. Inter and intra judge reliability measures were computed. In addition, we examined the frequency of occurrence of the different variants in this sample.

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### **Effects on Vocal Quality Following Decreased Fluid Intake**

Recommendations for increasing fluid intake have long been standard protocol in the management of voice disorders, however, this claim has not been substantiated in the literature. Nevertheless, clinical advice to improve hydration status is widely accepted as part of a comprehensive voice therapy regime. This study examined the effects of decreased hydration status on several vocal parameters during a period of no-fluid intake. A relatively large group of 45 healthy subjects was examined, 25 males and 25 females, trained singers and non-singers with a control group. Subjects participated in two identical vocal assessments, the first in early a.m. and the second at least six hours later. Subjects refrained from ingesting any liquids or foods with high water content between the two assessments. Vocal parameters of interest included objective measures (jitter, shimmer, fundamental frequency, pitch range, noise-to-harmonics) and subjective measures (self and clinician perception of vocal effort and quality).

Results indicated numerous differences between the a.m. and p.m. assessments, particularly in male non-singers. Jitter percent, fundamental frequency, and rating of effort increased significantly. These changes in vocal parameters are consistent with decreased vocal cord flexibility and/or decreased mass per unit area. This may be a result of decreased moisture content occurring within the vocal folds over six-to-eight hours of “no hydration.” Results are discussed in the context of potential effects of reduced hydration levels in vocal fold mucosa, voice quality, and sex differences. Substantial clinical implications are outlined with respect to vocal therapists and coaches.

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**The Impact of Intensive Voice Treatment (LSVT LOUD) vs. Intensive Articulation Treatment (LSVT ARTIC) on Facial Expression in Parkinson Disease**

It is widely recognized that diminished facial and vocal expression associated with Parkinson disease (PD) negatively impacts communicative success. Over many years, intensive voice therapy (LSVT LOUD) has been shown to effectively treat voice and speech deficits in PD. Preliminary research also suggests that LSVT LOUD has the potential to improve observers' perceptions of facial affect. Here, we review two recent studies which further examine the effects of LSVT LOUD on facial expression in PD. Both compare LSVT LOUD to an intensive articulation therapy – LSVT ARTIC – in an effort to clarify whether it is the *mode* (intensive, frequent) or *target* (voice vs. articulation) of treatment that may impact expressivity. In the first study, 40 subjects with PD (assigned to LSVT LOUD, LSVT ARTIC, or untreated groups) and 11 healthy controls produced monologues describing extremely happy events, before and after treatment (or no treatment). The Facial Action Coding System was used to evaluate 3 parameters of facial expression – *totality* (total number of facial expressions), *variability* (unique number of facial expressions), and *complexity* (number of discrete components in a facial expression). Significant improvements in *totality* ( $p=0.02$ ) and *variability* ( $p=0.01$ ) were seen following LSVT LOUD. In the second study, naïve observers evaluated the same monologues from a subset of subjects (25 with PD, 9 without). Analysis of Variance revealed that women with PD showed a greater increase in the frequency of facial expressions following LSVT LOUD ( $p=.002$ ). Results suggest that targeting voice, but not articulation, may have a beneficial effect on facial expression.

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## **Vibrato, Non-Vibrato and Indicators of Fatigue: Questionnaire Responses and Objective Data**

The author pilot-tested a survey on singing training and the possible after-effects of performing with and without vibrato on 213 singers in choirs in San Antonio. The survey instrument was revised and used to survey 350 singers, voice teachers and choir directors in the US and other countries using SurveyMonkey. Results of this international survey will be presented, along with data gathered on 30 additional singers (university voice majors) who took the survey multiple times to test the survey's reliability. This group of 30 singers also provided vibrato and non-vibrato singing samples and took the widely used Singing Voice Handicap Index (SVHI) survey. This data has been examined to see if responses to the author's survey have any correspondence with vibrato rates and extents, the jitter and shimmer of non-vibrato singing and scores on the SVHI.

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## Electroglottographic Analysis of Actresses and Non-Actresses' Voices in Different Levels of Intensity

Previous studies with LTAS showed the importance of the glottal source for understanding the projected voices of actresses. In this study, electroglottographic analysis (EGG) was used to investigate the contribution of the glottal source to the projected voice, comparing actresses and non actresses' voices, in different levels of intensity.

*Method.* 30 actresses and 30 non-actresses sustained vowels in habitual, moderate and loud levels. The EGG variables were Closed (CQ), Closing (QCQ), Opening (QOQ) and Open Quotients (OQ). Other variables were Mean Sound Pressure level (*Leq*) and Speaking Fundamental Frequency (SFF). A KeyPentax Electroglottograph was used. Variables were inputed in a general linear model.

*Results/Discussion.* Actresses showed significantly higher values for *Leq*, in all levels, and both groups increased *Leq* significantly while changing for habitual to moderate and further to loud. Only OQ showed significant differences between actresses and non-actresses, and only in loud level. For all other there were not significant differences between groups in all levels. There were significant differences between levels only for SFF and CQ for both groups.

*Conclusion.* *Leq* was significantly higher among actresses in all levels, but in the EGG analysis, only the OQ of actresses' voices, in loud level, significantly increased when compared to non-actresses. This apparently weak contribution of the glottal source in the supposedly projected voices of actresses, contrary to previous LTAS studies, might be due to a perhaps greater importance of the vocal tract for *Leq*. However, further studies should use similar vocal emission tasks for both EGG and LTAS analysis.

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**Overtone Singing & Classical Indian Music:  
The introduction of a hybrid-genre**

The aim of this work is to study the compatibility between overtone singing and Indian classical music. It explores practically how these two viable genres could be used together to achieve a sophisticated, yet aesthetic, hybrid-genre. One key objective is to simultaneously be creative within explicit parameters, in order to maintain stylistic integrity, without losing musical relevance and aesthetic value.

The main factor that distinguishes this hybridised form from most traditional overtone singing is that it has a well worked out theory describing how to consciously control both fundamental and overtone semi-independently. This is a prerequisite in any form where movement of the fundamental is incorporated with movement of the overtones. This task is further complicated by introducing the rāga parameters. Each rāga has its own set of notes that cannot be freely used without complying with specific rules.

Although one can find primitive fundamental changes, in addition to the overtone melody, in the South African Xhosa tribal singing called Umngqokolo (Dargie, D. 1988), the fundamental usually only shifts between two notes. It does not reveal a formula or method advanced enough to support an advanced level of rāga development.

This workshop will demonstrate some of the more common and distinctive Indian idioms such as time cycle rāga movement, voice throw and general build-up of a rāga. Once these aspects have been properly established, then overtones can be fit into the structure unobtrusively.

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### Resonance Strategies in Rock Singers

Low fundamental frequencies in singing voice produce a dense row of harmonics such that formants in the spectrum without adjustment are effective at any frequency. On the other hand, the wide spacing of the harmonics of higher fundamental frequencies requires careful tuning of formants, which boost a limited bandwidth of frequencies and lose effectiveness if located far from a harmonic. Vowel modification is usually the way to get an appropriate formant tuning in high pitches in singing voice. Reinforced falsetto is one of the vocal resources used by rock singers in high pitches. This kind of phonation is commonly associated to shortening of the vocal tract and opened vowel production. The purpose of this study is to determine the resonance strategies of rock singers in high pitches singing with reinforced falsetto. Twelve rock singers were recruited for this study and each subject was asked to produce the highest possible pitch using reinforced falsetto. Acoustical analysis was performed using Voce Vista software. Resonance strategies were determined by seeing the coincidence between formants and harmonics in every recorded sample. Three main resonance strategies were obtained: 1) First two formants with second harmonic (F1-F2/H2), second formant with second harmonic (F2/H2), and first formant with first harmonic (F1/H1). These strategies were dependent of the fundamental frequency.

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### Voice Use of a Private Studio Voice Teacher: A Case Study

It is well documented that teachers suffer the highest rate of vocal problems of any population group. With the advent of vocal dosimeter technology, numerous studies have documented the real-time voice use of classroom teachers (Titze, Hunter & Svec). Morrow & Connor (2010) used vocal dosimeters to record voice use data of classroom music teachers and found that this subgroup recorded significantly higher doses than other classroom teachers. Schloneger (2010) found that two opera graduate teaching assistants' highest percentage of voice use occurred in teaching situations. No studies to date, however, have analyzed the voice use of full-time private studio voice teachers. Real-time data obtained through APM units, coupled with perceptual analyses of vocal health, could help develop a more complete picture of voice use and vocal efficiency among studio teachers.

The purpose of this case study was to assess vocal doses acquired by a voice professor ( $N=1$ ) at a small liberal arts college over 11 full days through the use of Ambulatory Phonation Monitors. Monitoring included four baseline (non-teaching) days and seven teaching days. For comparison, teaching days were divided between the first and ninth week of the semester. Vocal dose was measured in tandem with daily surveys of self-perceived vocal health and efficiency. Results were discussed in terms of voice use (vocal dosage, mean F0 and mean SPL dB levels) in and out of rehearsals and any changes that occurred in vocal efficiency during this intensive period.

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## The Viability of Melodic Contour Mapping Technology for Training Classical *Legato* Singing in Collegiate Singers

*Introduction.* A study of Melodic Contour Mapping Systems and vocal timbre in classical singers was published in *Journal of Voice* by Barnes-Burroughs, Anderson, and Hughes, et.al. in November 2007 (21:6, 689-698). Discussion indicated that some improvement in *legato* singing was informally observed in its test subjects.

*Objective.* The purpose of this study is to evaluate self-perceived changes and professional perceptual measures of improvement in *legato* classical singing produced by undergraduate collegiate singers after training with Melodic Contour Mapping Technology (MCMT).

*Methods.* Twenty classical singers, between the ages of 17 and 25, who were currently taking collegiate voice lessons and reported no current or historical voice pathology, were trained with MCMT prior to testing. Experimental subjects were recorded while singing an originally-composed melody on the IPA vowel [a] under 3 conditions: (a) singing while reading traditional musical notation; (b) singing while reading traditional notation and a simultaneous computer display of the melodic contour, with the verbal cue: “please sing a more *connected* line;” and (c) singing while reading traditional notation alone. An equivalent control group was tested across the 3 conditions, without MCMT. Exit surveys were compared with perceptual evaluations by five university-vetted, rating-trained voice teachers.

*Discussion.* Based on differences and similarities within these results, discussion focuses on the perceptions of *legato* singing as it may be influenced by training with Melodic Contour Mapping Technology and the pedagogical implications that may be revealed for MCMT inclusion in classical voice programs.

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### **The *Secondo Passaggio*, a Registration Transition Based on Pitch and Vowel**

The purpose of this research is to determine whether the *secondo passaggio* is a stationary registration event or transitory, based on the degree of vowel closure. From the time of Manuel Garcia II, pedagogues have recognized the value of being able to sing certain pitches in different registers as a means of establishing proficiency in the ability to sing a smooth register transition as well as *messa di voce*. Further understanding of how registration events play into this concept is needed. Twenty male singers, who can successfully demonstrate the ability to navigate into their head register, (passing through the *secondo passaggio*) will be utilized for this study. Data will be collected using a head mounted microphone and an electroglottograph. These signals will be displayed and analyzed for spectrographic and closing quotient values using the VoceVista software. Singers will sing three scales on [i], [e] and [a] vowels whose pitch levels will ensure transition from the chest register to the head register. Resonance strategies will be monitored during the singing of these scales and registration events will be noted. A comparison will be made of these three vowels to determine if a register transition (*secondo passaggio*) has occurred, where it has occurred and how it is similar or different from the other vowels.

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### **Objective Characteristics of Extended Female "Belting" Range**

In the category of singing that some have labeled "contemporary commercial music" (CCM), a recent trend has been to extend the upper limit of the range beyond ca. D5 (587 Hz), the approximate end of the range of the traditional female "belt" voice. The purpose of our investigation is to measure key objective parameters of this production through signals registered non-invasively by microphone and electroglottograph (EGG). The key parameters are formant frequencies and the glottal closed quotient, estimated by means of spectrum analysis and EGG, respectively. Our 5 subjects are singers who can readily produce the requisite sounds, in the range F5 to A5-flat, selected from the studio of one of the authors, David Sabella-Mills. The results show singing voice production in which the second harmonic is clearly higher, on the highest pitches, than the frequency of the first formant, together with closed quotients considerably greater than 50%.

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## **The Changing Aesthetic of the Broadway Belt As Seen in the VLTAS**

The contemporary Broadway stage requires that performers be skilled in both ‘legit’ and ‘belt’ vocal production. The first generation of Broadway belters did not benefit from amplification technology, but currently every Broadway show utilizes sound reinforcement. A shift in the aesthetics of belt can be identified from the belters of the 1930s through the contemporary Broadway stage. While research on Contemporary Commercial Music (CCM) has developed methodologies for teaching belt and defining belt, tracking the aesthetic shift of belt throughout the twentieth and twenty-first centuries has not been sufficiently examined in the research. The purpose of this study is to identify timbral changes in the vocal production of belt from the 1930s through 2011. The long-term average spectrum (LTAS) is widely accepted as a tool for measuring voice quality. To analyze longer selections of recordings, a new version of VoceVista-Pro was commissioned by Shenandoah University to provide a “very long-term average spectrum” (VLTAS). The VLTAS processes LTAS data of a duration up to three hours, a feature unavailable in other programs. This study will examine VLTAS data of original and revival Broadway cast recordings throughout the twentieth and twenty-first century to demonstrate the perceived shift in the timbre of belt.

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## **The Efficacy of Vocal Function Exercises in the Practice Regimen of Undergraduate Musical Theatre Majors**

Musical theatre performers are versatile artists who face grueling schedules, experience high rates of vocal problems, and may be trained by teachers with little or no experience in musical theatre styles. In light of these challenges, it is imperative that these performers develop strategies to promote wellness, health, and physiologic efficiency of the vocal mechanism.

Vocal function exercises (VFE) have been shown to have a positive effect on the phonation systems of both classical graduate singers and amateur choral singers over age 50, yet research to date has not examined the efficacy of VFE with musical theatre singers. The purpose of this study is to demonstrate the effects of VFE on the vocal production of young musical theatre singers in a pre-professional training program.

Thirty undergraduate musical theatre majors will be randomly assigned to treatment and control groups, each containing 10-15 subjects. Subjects in the treatment group will complete VFE, while subjects in the control group will complete a set of placebo exercises. All subjects will be screened for pathology and will continue their normal singing routines over the 6-week duration of the experiment. Assessment will include pre- and posttest acoustic, aerodynamic, and subjective evaluations.

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## **Perceptual and Acoustic Assessments of University Voice Practice Rooms**

University students whose major instrument is voice may spend the bulk of their rehearsal time in individual practice rooms provided by the university. Currently there appear to be no published guidelines for the construction of these practice rooms and no published studies that analyze the acoustical properties of individual practice rooms at particular universities. Prior studies have indicated that different singing environments may affect vocal output (Rothman, Brown, & LaFond, 2002).

The purpose of this study was twofold: (a) to determine singers' perceptions of individual practice rooms at a large Midwestern University, and (b) to perform acoustical analyses to test for room characteristics that could influence those perceptions. Undergraduate and graduate vocal performance students ( $N = 60$ ) responded to a survey asking them to list their most preferred and least preferred university practice rooms, and the reasons for their preferences. Impulse response tests were then conducted in the two most preferred and two least preferred practice rooms, using EASERA 1.2.2 to determine reverberation rates and reflections produced in each room. A fifth practice room adjacent to one of the chosen rooms was used to determine noise reduction rates between adjacent practice rooms at this University. Results were discussed in relation to practice room construction, vocal pedagogy, and implications for future research.

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### Effects of Three Conducting Gestures on Soprano Choral Sound

Some conducting pedagogy literature evidences testimonial belief that nonverbal conductor gestures, particularly gestural direction (vertical, lateral), affects the tone quality and intonation of choir singing. The present investigation compared in a naturalistic choral singing context potential effects of three right hand conductor gesture strategies (traditional pattern, lateral gestural plane only, vertical gestural plane only) on the aggregate, choral sound of a choir soprano section singing an excerpt from a movement of Faure's *Requiem*.

Choristers ( $N = 10$ ) sang from memory on riser units in a choral rehearsal room. During rehearsals in the same room prior to a recording session, the conductor used no arm/hand gestures in teaching the excerpt. To control for variability in conductor behavior and tempo during recorded trials, singers viewed videotaped conducting. Frame comparisons and evaluations by experienced conductors confirmed the conductor's facial expression, hand shape, and distance between lateral-only and vertical-only gestures remained consistent across conditions.

An Edirol R-109 digital sound recorder positioned 3.8 m from the front row of singers captured each performance at a sampling rate of 44.1 kHz (16 bits) in .wav format. Recordings were evaluated acoustically (LTAS) and perceptually (expert listening panel ratings). Intonation of two recurring vowels (/eh/, /u/) was examined using MAX-MSP pitch analysis procedures. Participating singers completed a brief survey at the conclusion of the recording session. Results were discussed in terms of current pedagogical beliefs and directions for future research.

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## **The Silent Practice: A Specific Way to Improve the Sensory Proprioception of Laryngeal Muscles During Vocalization**

Laryngeal proprioception is an essential factor in voice feedback control, really important in situations of reduced auditory feedback (AFB) and of impaired laryngeal muscles (LM) coordination. Since there aren't muscle spindles in thyroarytenoid/cricothyroid (TA/CT), laryngeal mucosal receptors, not proprioceptive afferents, are capable of conveying sensory informations related to TA/CT tension and vocal fold movements during vocalization.

Our aim was to find the way to consciously increase the laryngeal muscles proprioceptive feed-back, in absence of voice AFB, as in case of silent practice (SP), in order to improve LM control.

We recorded endoscopies in 10 professional voice users, more or less experienced of EVT method, asking them to performe 3 specific compulsory figures to assess movements in the spatial axes: false vocal folds retraction (x-axis), thyroid cartilage tilting (y-axis), aryepiglottic spincter constriction (z-axis). All figures were performed in SP, first in empty relaxed apnea, then during slow expiratory airflow simulating the vowel /I/. All videos were judged by 10 experts of the EVT method (4SLP, 3MD, 3 voice teachers).

In conclusion we show results, suggesting modes to improve voice control through the SP, increasing vocal sensory proprioception, knowledge and awareness of LM movements. This practice could be useful in many situations: in case of reduced AFB (Lombard effect), especially in professional voice users; in dysfunctional and organic dysphonia, facilitating the development of a proper muscular memory, shortening the motion learning time, even in logopedic rehabilitation; during learning of vocal technique and to warm up or exercise the voice in any context.

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**Acoustic and Perceptual Comparisons of SATB Choir Performances in Two Auditoria, with Three Chorister Spacing Conditions, Two Heights of Choral Risers, and Three Microphone Locations**

This is the third in a series of studies exploring potential effects of chorister spacing and riser step heights on choral singing production and propagation.

Under controlled conditions, we assessed 12 performances of an SATB choir ( $N=32$ ) both acoustically (LTAS, and smoothed one-third octave band analyses) and perceptually (listener ratings, singer perceptions). Choristers performed the same musical excerpt six times in two auditoria. Sung trials in each auditorium included three chorister spacing conditions (close, lateral, circumambient) on each of two riser units (regular riser step height, taller riser step height). Sound data were acquired from three, calibrated Earthworks precision omni-directional microphones, placed at ear heights in a conductor position, an early audience position, and a mid-hall position in each auditorium.

We assigned singer positions randomly within a block sectional choir formation used throughout the study. The choir practiced equal amounts of time on each riser unit in each spacing condition prior to the recording sessions. Videotaped conducting served as a control for tempo consistency and assured that singers responded to precisely the same conductor behaviors in all sung trials. We discussed results in terms of voice-friendly choral performance practices and suggestions for future research.

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### **Who's Teaching What with Pop/Rock Singers?**

The marketplace for pop/rock singing is robust. The Nielsen Company reported \$6.85 billion in 2010 record sales in the USA. Broadway and Equity touring productions, primarily pop/rock in style, earned \$1.8 billion in ticket sales for the 2009-2010 season. In the same season \$305 million dollars in box office receipts were reported for opera performances. According to NASM there are over 9,000 students enrolled in vocal performance programs at 383 universities. Only 11 universities offer music industry programs, and there are no pop/rock voice performance degrees in the United States.

Recent research has indicated that functional differences may exist between rock and classical vocal production, and specialized instruction is required for rock/pop singers. CCM voice pedagogy surveys indicate that fewer than 30% of responding have expertise in this style, and less than 20% of voice teachers work with pop/rock singers.

Many singers supplement their income with studio teaching, but only two collegiate programs for CCM vocal pedagogy exist in the United States. What exactly is being taught to pop/rock singers by these teachers? This survey will examine what specialized training exists for these singers in vocal studios throughout the United States.

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### **Effects of Forceful/Effortful Word Priming on Vocal Production of Individual Singers**

Previous research has indicated that sentence construction tasks containing certain behavioral priming words can nonconsciously affect participant behaviors (Bargh, Chen, & Burrows, 1996). Moreover, some choral and vocal pedagogues have suggested that an instructor's choice of delicate or harsh words in vocal music contexts might nonconsciously affect efficient vocal production (Thurman and Welch, 2000).

The purpose of this investigation was to assess potential changes in vocal output (amplitude, spectra, onsets) compared to baseline data when participants ( $N = 45$ ) sang a melody after being supraliminally primed with forceful/effortful descriptor words. Participants sang a familiar melody prior to and after completing a sentence construction task. The task involved creating four-word grammatical sentences from 30 sets of researcher-constructed five-word groupings as quickly as possible. Each word grouping contained a forceful/effortful descriptor priming word.

An Earthworks precision instrumentation condenser mic, calibrated with a Cirrus CRL 511E microphone calibrator, acquired audio recordings. Differences between baseline and posttest recordings were subsequently analyzed perceptually (listener ratings, singer perceptions, and visual spectrographic analysis) and acoustically (amplitude, spectrum). Results were discussed in terms of instructor word choices in vocal music contexts and suggestions for future research.

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**“Singing in the Mask” or “Formant Tuning”?  
A Comparative Analysis of Collegiate Voice Faculty Vacancies: 1999-2012**

To what extent should the marketplace influence collegiate curricula? How does expertise in foreign language diction, opera, and vocal song literature compare to the growing demand for knowledge in vocal science, studio-technology and contemporary commercial music (CCM)? Do doctoral programs, the traditional training ground for university voice faculty, adequately prepare students for viable employment in the 21st century?

A careful analysis of current market trends indicates that the landscape is rapidly changing for the voice teaching profession at the collegiate level. The purpose of this study is to quantify this change, as seen in university voice faculty vacancy listings. A compelling shift in the past decade towards science, technology and CCM singing can be observed. The curricular ramifications of this development in vocal pedagogy and vocal performance will be examined.

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### **Expert Listener Perceptions of Voice Quality and Age in Pre-, Peri, and Post-menopausal Female Singers**

This case study examined listener perception in  $N = 307$  female singers according to age, hormonal stage status (pre-, peri-, and post-menopause), hormone replacement therapy use, singing experience (moderate and advanced), and preferred singing mode (solo or choral). The first phrase of the song *Over the Rainbow* {"Some- (octave leap) where over the rainbow"} by Harold Arlen was sung by each participant, and recorded (Edirol R-09) in a quiet room. An expert listening panel ( $N = 5$ ), comprised of five classically-trained vocal music educators, listened to the phrases presented in a random order to avoid menopausal stage groupings. Each panel member rated each singer's vocal quality on a Likert-type scale from level 1 ("breathy" phonation) to level 7 ("pressed" phonation). Panel members also individually selected an age grouping corresponding generally to the menopausal stage (20 – 39 years, pre-menopause; 40 – 58 years, peri-menopause; and 59 – 80 years, post-menopause) for each singer. Findings were discussed in terms of listener age-perception accuracy, voice pedagogy with suggested exercises for experienced, adult female singers in each hormonal stage, limitations of the study, and suggestions for future research.

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### **Pitch Matching Ability Based on Voice Category and Method of Stimulus Presentation**

Research has shown that female singers are better able to match pitch when the target stimulus is produced by female singers as compared to instruments. This study seeks to answer the following questions: 1. Do classically trained female singers more accurately match pitch when the target stimulus is produced by a singer of the same voice category? 2. Can classically trained female singers match pitch to a synthetic voice with the same accuracy as they do to a real voice? 3. Does the ability to match pitch vary with increasing pitch? Does pitch matching ability vary depending on the method of stimulus presentation?

**Stimuli:** Three sopranos and three mezzo-sopranos with at least 3 years of individual voice training will be recruited from the University of Tennessee School of Music and the Knoxville Opera Company. Each singer will be recorded singing “ah” on the pitches C4, B4, and F5. Synthetic voices based on the spectral distribution of the real voices will also be constructed at the same pitches.

**Procedure:** Ten sopranos and 10 mezzo-sopranos with at least 3 years of individual voice training will be recruited from the University of Tennessee School of Music and the Knoxville Opera Company. Each singer will attempt to match the pitch of all 6 real singing voices and all 6 synthesized singing voices in the following conditions: (1) simultaneous in a free field using a contact microphone; (2) simultaneous over headphones using a dynamic microphone, (3) sequentially in a free field using a dynamic microphone.

Molly L. Erickson, Ph.D., M.M. CCC-SLP, Associate Professor, University of Tennessee, Health Sciences Center, 578 South Stadium Hall, Knoxville, TN 37996

Marnie Pomeroy, M.M., AUD student, University of Tennessee, Health Sciences Center, 578 South Stadium Hall, Knoxville, TN 37996, (865) 356-8884

### **The Effect of Vibrato in Maximizing Vocal Production as Seen in the Messa di Voce (MDV)**

Vibrato is an important vocal quality in many forms of western music, but the training and acoustic qualities of vibrato are not fully understood. Data in previous studies indicate that vibrato and vocal warm-up exercises serve to maximize vocal production, enhancing spectral and dynamic measures.

The messa di voce (MDV) is a vocal technique in which a single pitch is sung with a gradual crescendo and decrescendo. This requires an extremely high level of vocal coordination, particularly in the decrescendo phase. The utility of MDV as a sung token in voice research has been demonstrated.

Twenty undergraduate voice majors 18 to 24 years of age will be selected and instructed in proper MDV technique at prescribed pitch levels. Thirty-two samples per subject will be gathered over four recording sessions: four MDV samples per session with vibrato and four MDV samples without vibrato. The vibrato–nonvibrato task order will be randomized within each session.

These 640 samples will be recorded and digitized for acoustic analysis. Measures will include spectral measures (harmonic-to-noise ratio, cepstral peak prominence), intensity measures (mean dB, max dB, and min dB), and duration measures (sample length, crescendo phase duration, decrescendo phase duration).

David Meyer, DM, Associate Professor of Voice and Vocal Pedagogy, Shenandoah Conservatory, 1460 University Drive, Winchester, VA 22601

Philip Sargent, DMA, Associate Professor of Music, Shenandoah Conservatory, 1460 University Drive, Winchester, VA 22601

Colleen Cook, MM Vocal Pedagogy candidate, Shenandoah Conservatory, 1460 University Drive, Winchester, VA 22601

### **Voice Training: Bioenergetic Analysis and Proprioception**

Innovation to voice training involves bioenergetic analysis and proprioception. Since bioenergetic analysis has proven that what affects the mind also affects the body, I have determined that a student's inability to access an awareness of physical tensions and inhibitors is directly related to his/her patterns of chronic muscular tension(s). These tensions prevent an actor from freely utilizing his/her breath resulting in the loss of physical and emotional freedom. To aid in the elimination of these tensions, an actor engages in proprioceptive movement, which allows the body to move freely in space as a means of enhancing an actor's awareness of the movement of his/her limbs. This awareness is triggered through movement by "sensory information from certain proprioceptors (receptors in joints, tendons, muscles), particularly those in muscles and tendons used by the motor system as feedback to guide postural adjustments and control of well-practiced or semiautomatic movements such as those involved in walking." Furthermore, the exploration of these "postural adjustments" will ultimately allow an actor to unlock repressed emotions, which will release psycho-physiological (mind-body) blocks.

Tamiko S. Washington, Associate Professor of Theatre, Chapman University, Department of Theatre, College of Performing Arts, One University Drive, Orange, CA 92866

### **Muscle Tension Dysphonia: Are Singers Getting the Help They Need?**

Muscle tension dysphonia (MTD) is an occupational hazard for both the professional and amateur singer. The demanding nature of the job is such that performers are frequently faced with situations that may contribute to the development of the disorder. MTD can have a significantly negative impact on a performer's career and confidence, making early detection and treatment a necessity for the singing voice. Due to the difficult nature of detecting, diagnosing and treating the disorder, the involvement of the laryngologist specializing in the singing voice is imperative when a singer exhibits symptoms of vocal hyperfunction.

Prior research has suggested both that singers may be reluctant to seek medical treatment, and that there may be a lack of education amongst voice professionals (such as teachers and coaches) concerning the diagnosis and rehabilitation of the disordered singing voice. This study sought to determine not only whether singers are likely to receive the necessary referrals and encouragement to consult a medical voice specialist, but also whether voice professionals agree as to when a referral may be appropriate.

In addition to using the traditional question-answer format to ascertain familiarity with the disorder and its symptoms, participants were asked to listen to audio clips of singers and provide feedback in order to determine whether there are aural models of MTD that can aid in recognition of the disorder.

Findings are presented with the aim of contributing to current understanding the level of MTD awareness in the singing community.

Jeanne Goffi-Fynn, Ed. D., M.M., Director – Doctoral Cohort Program, Lecturer in Music, Columbia University, Teachers College, Music and Music Education, 525 West 120th Street New York, NY 10027-6696

Felicity Graham, B.S., M.A., Research Assistant, Columbia University, Teachers College, Music and Music Education, 525 West 120th Street New York, NY 10027-6696

**The Current State of Vocology for the Singing Voice: A Review of Technology, Medical Applications and Educational Opportunities**

Vocology, the science and practice of voice habilitation, is a relatively new field of study that grew from the intersection of voice science, medicine and voice pedagogy (Titze, 1996). Vocology encompasses all aspects of both the singing and the speaking voice, but this presentation will focus on a review of the current state of singing voice vocology. At present, there is no central, up-to-date resource for singing voice vocologists to access practical information regarding technology, medical applications and educational opportunities. This review is intended to gather vital information deemed to be useful for the diverse professionals and students in the field of singing voice vocology, including singing voice specialists, singing voice teachers, speech language pathologists, voice scientists, and laryngologists.

At the beginning of the presentation, vocology is defined and a brief history of the field is provided. Next, a review is given of the current state of technology (i.e. high-speed stroboscopy, acoustic analysis, EGG), medical applications/intersections (i.e. voice care team, collegiate model of pairing incoming students with voice centers, singing voice therapy techniques, vocal health, alternative medicine, general practical resources), and educational opportunities (i.e. university programs, conferences, classical vs. non-classical pedagogy). Lastly, future directions are established based on current trends and apparent needs in the field.

Julia Madden, MM, MA-SLP, DMA in Voice Performance/Pedagogy expected May 2012, Temple University, Philadelphia, PA



### Vocal Registers of the Countertenor Voice

To date, our understanding of the registers of the countertenor voice has been limited. The findings of this study indicate that today's countertenors make register transitions similar to those of the mezzo-soprano. The primary register transition from the chest to middle register ranges from pitches B3 to E4, and is primarily characterized by a decrease in closed quotient. An audibly smooth transition corresponds with a gradual and slight adjustment in CQ, rather than a drastic change. The transition from the middle to the upper register takes place in the range of pitches between C#5 and E5, and is characterized by both an increase in closed quotient and a shift in the relative amplitudes of the first and second harmonic (H1 and H2).

The data in this study was obtained from established and emerging professional countertenors in North America. Audio and electroglottograph signals were recorded using a standard protocol primarily consisting of scales and arpeggios on open vowels. The recordings were made without musical accompaniment.

Ray Chenez, DM, Vocal Performance, Instructor of Voice, University of Alabama, Box 870366,  
School of Music, Tuscaloosa, AL 35487-0366

**What's in a Name? An Exploration of the Interdisciplinary Terminology Used to Describe Breathing For Singing**

Part of The Voice Foundation's mandate is to bring together physicians, scientists, speech-language pathologists, teachers and performers to share knowledge and expertise concerning the voice. But does each field completely understand the other? When a physician, for example, uses the phrase 'breath support', is the physician's intent understood by the performer? By the teacher? Or by speech-language pathologist?

This paper constitutes a brief overview of the results of research into the treatment of terminology used to describe breathing for singing in field-specific literature (from choral and solo-voice pedagogy literature, through speech-language pathology literature, to literature written by and for physicians specializing in treatment of the voice) from the 1980s to the present day. The questions to be answered are: Is there standardized terminology emerging in each field? Is there standardized terminology emerging across the fields? If so, what is that terminology? And if not, is there terminology that may be useful to, and understood equally well across all of the disciplines concerned with the voice?

Shannon Coates, Doctor of Musical Arts (Vocal Performance and Pedagogy) Candidate, University of Toronto

### **Vocal Practice Routines of Indian [Hindustani] Classical Singers**

Singers of Hindustani vocal music are found in urban centres throughout North India, Pakistan and Bangladesh--and many are found in North America, Europe, and East Africa. After many years of rigorous training and practice, vocalists attain remarkable speed, clarity, volume, and intonational precision. For this reason, many semi classical and popular music singers are also trained in classical Indian singing. Continuous lineages of vocalists in this tradition reach back to the sixteenth century. "Voice culture," or methods of cultivating the voice, is a major part of voice training in these vocal lineages. Many ethnographic studies report esoteric vocal practices that grant singers extraordinary vocal powers—such as practicing for twelve hours at a stretch, singing a single phrase thousands of times, or practicing in isolation for forty days. However, until now there has been no formal research on actual methods of training, practice, warm-up, and performance in khyal singing. This paper is an attempt to do just that. We will present a preliminary report on the results of a survey administered to a wide range of Indian vocalists to assess their warm up, practice, and performance routines. A greater understanding of the vocal practice and training of Indian singers will allow for a tailored approach to assessing and rehabilitating voice problems, in light of an individual's singing requirements, while remaining sensitive to the cultural and aesthetic requirements of the Hindustani classical vocal style. This may not only improve individual treatment outcomes, but also open avenues for the exchange of best vocal practices among different musics throughout the world.

Sadhana Nayak, M. S. [Otolaryngology], Fulbright Nehru Fellow 2011-12, Founder & Director, AAROHA- The Voice Clinic, 131-B, Tanna Residency, V.S. Marg, Prabhadevi, Mumbai, India

Matt Rahaim, Ph. D [Ethnomusicology; Assistant Professor of Music (Ethnomusicology), University of Minnesota, U.S.A

### Postural Assessment of Sopranos During the Interpretation of an Opera Aria

The opera singing is an activity which requires postural control during performance, as changes in posture may affect the emission of sung voice. Aim: to evaluate the body posture of sopranos during the interpretation of an opera aria. Method: the subjects of this study were 18 professional opera singers, who were filmed in studio while singing the aria "*Dove Sono i bei momenti*" (Mozart). Two cameras were used for filming: one in a frontal plane, and the other on the right-hand side. The images were analyzed using the postural assessment software (SAPO) in three different moments: orthostatic, during the emission of note F4 and A4. The angles of position of the head, shoulders and inferior members were measured in the frontal plane, and the position of the head, trunk, hip, and inferior members were measured in the right lateral plane. The averages and standard deviations were calculated for all measurements. Results: There was no observed significant difference between the averages of anterior variation of the head ( $p=0,146$ ), anterior variation of the shoulders ( $p=0,221$ ), profile trunk variation ( $p=0,077$ ) and profile hip variation ( $p=0,691$ ). On the other hand, there were statistically significant differences between the averages of anterior variation of the inferior members, for the right-hand side ( $p=0,049$ ) and to the left-hand side ( $p=0,028$ ) and the variation between the averages profile of the head ( $p<0,001$ ). Conclusion: the sopranos in this study made upward head adjustments, separated their feet and stretched their legs during the emission of the high note.

Enio Lopes Mello, MD, Doctoral student; Body therapist; classical singer, Member of LABORVOX (Voice Laboratory) Pontifícia Universidade Católica de São Paulo, Rua Monte Alegre, 984 - São Paulo - SP – Brazil

Suely Master, PhD, Speech Language Pathologist (SLP) and Professor , Arts Institute (UNESP), Rua Dr. Bento Teobaldo Ferraz, 271. São Paulo. Brazil

Marta A. de Andrada e Silva, PhD, Speech Language Pathologist and professor, Member of LABORVOX; Pontifícia Universidade Católica de São Paulo and University Medicine of Santa, Casa de Misericórdia São Paulo, Rua Monte Alegre, 984; São Paulo – SP- Brazil

### Impact of Performance Anxiety on the Accuracy of the Singing Voice Among Music Students

Performance anxiety causes physical and cognitive symptoms. This emotional state can affect the vocal features thus the fundamental frequency which is the main parameter to evaluate the singing voice accuracy. The aim of this study is to observe the impact of performance anxiety on the singing voice accuracy.

31 music students from the Royal Conservatories of Belgium sang a melody three times. Twice in quiet situations and one time in a stress situation (the day of the examination). This performance was rated by a panel of teachers. The anxiety level was controlled by measuring the heart frequency. We analyzed errors concerning the interval accuracy and the respect of the tonal center.

We observe that the heart frequency is significantly higher in the stress situation ( $F(2,28)=15,18$  ;  $p<.001$ ), especially for advanced students. The students have difficulty to maintain the tonal center ( $F(2,12)=7,17$  ;  $p=.03$ ), whereas the accuracy of the intervals is not altered ( $F(2,12)=1,1$  ;  $p=.56$ ). The rating of the jury correlates with interval accuracy ( $r=-.411$  ;  $p=.03$ ) and respect of the tonal center ( $r=-.452$  ;  $p=.016$ ), particularly at the beginning of the melody ( $r=-.516$  ;  $p=.005$ ).

To conclude, performance anxiety leads to an increase of the heart frequency and alters the respect of the tonal center. This is particularly the case for advanced students for whom this situation is a real challenge.

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Dominique Morsomme, PhD, Lecturer / Speech Therapist, Unit of Voice Speech Therapy, Department of Psychology: Cognition and Behaviour, University of Liège, B38, Rue de l'Aunaie, 30, 4000 Liège, Belgium

### **Asthmatic Female Adolescent Singers' Perceptions of Breathing and Vocal Production During Festival and Concert Season**

The purpose of this collective case study was to document and analyze asthmatic female adolescent singers' (N=4) voice use over an eight week period through (a) eight voice assessment protocols conducted every week, (b) pre-study survey, (c) daily participant journaling; and (d) a stroboscopic laryngeal examination. Participants were four adolescent females previously diagnosed with asthma by their personal physician. Singers completed a pre-study questionnaire regarding their perceived asthma symptoms and singing experiences as well as the Singing Voice Handicap Index. Singers were asked to do a short daily journaling form each week and returned them the following week. The journaling consisted of questions regarding singing activity, perception of breath, use of asthma treatment and overall perceptions of singing and asthma symptoms. Singers visited an otolaryngologist for a videostroboscopic examination and assessment of their larynx immediately before the first voice assessment in order to determine their level of vocal health prior to the study. Following these examinations, voice assessment protocols were done each week for eight weeks. During each protocol, participants completed an s-z ratio, recited the Rainbow Passage (recorded using Real-Time Pitch in CSL(Computerized Speech Lab)), sang vowel sounds, did vocalizations, sang a short song and were evaluated on posture, jaw tension and tongue position. Findings were discussed in terms of vocal pedagogy practices and suggestions for future research.

Melissa C Brunkan, M.M., PhD Candidate, Vocal/Choral Pedagogy Research Group, The University of Kansas, 1530 Naismith Dr. Lawrence, KS 66045

### **Timbre Transitions in High-Pitched Male Musical Theater Singing**

Belting is a vocal technique that is frequently associated with musical theater singing. Although many studies have been performed on female belting, the amount of information that is available on male belting is limited. In this treatise, the phonations of eleven male subjects were analyzed in order to achieve a better understanding of the male musical theater voice. Spectrographic images were created using the VoceVista software and images were analyzed and compared between multiple subjects singing in multiple timbres. The results show that male musical theater singers are capable of producing both belted and non-belted timbres during high-pitched singing, and that the differences in timbre are created by changes in formant tuning strategies. Comparisons to preexisting studies on female belting show that male musical theater singers utilize similar formant tuning strategies during belting as do female musical theater singers.

Aaron Grant, DM, Student, Florida State University, 122 N Copland St. Tallahassee, FL 32306

### **Commercial Genres**

Commercial vocal music includes such genres as pop, rock, jazz, country, and soul. Each of these genres contains unique ingredients such as timbre, vibrato quantity and type, registration choices, airflow, dialect, attitude, phrasing, physical mannerisms, and 'stylisms' (such as growls, cries, falsetto flips).

In this master class, participants will have the opportunity to observe three singers work in their preferred genre to refine technical and stylistic choices to authenticate and 'sell' their genre.

Lisa Popeil, MFA in Voice, Voiceworks® Method and the Total Singer DVD., Los Angeles, California, 14431 Ventura Blvd #200, Sherman Oaks, CA 91423



**The Vocalist Studio – A New Method of Using Sequential Work Flows, Onsets and Sirens for Training High Performance Singing Voices**

In this workshop, Robert Lunte will demonstrate a new approach to training singers that involves the calibration of the physiological and acoustic singing components required for great singing, into organized 'packages' and 'sets', groupings of technique details.

These grouped physiological and acoustic components are further organized into sequential work flows during the practice of original TVS vocalise to achieve an extremely calibrated and coordinated, high performance phonation that is applied to the art of singing. By training onsets and sirens with sequential work flows, the shortest path to building extraordinary muscle memory and auditory imagery skills needed for singing are developed in the shortest period of time.

Robert Lunte is the owner founder of the The Vocalist Studio (TVS), an internationally recognized voice training school for extreme singing vocal techniques and advanced vocal instruction. Robert is also the author and producer of the critically acclaimed vocal instruction training system, "The Four Pillars of Singing 2.0".

Robert Lunte, BA Music & Business Administration, Owner of Vocalist Studio & Founder of The Modern Vocalist, Owner of The Vocalist Studio, 9805 NE 116th Street, PMB 7114, Kirkland, WA 98034

## Standard Pedagogy and Technique For the Female Belt Voice

In this workshop I will explain a detailed, pedagogical approach to the female belt voice that is easily understandable for all voice care professionals. The purpose is to clarify the teaching of the belt voice so that more teachers will confidently know what they are doing and more singers will avoid vocal injury.

Topics covered will include:

Standard vocal technique for women

The breaking of the rules for belt voice

Human anatomy and physiology and the relation to voice type

The importance of voice type when identifying belt ability

The difference between belt voice for contraltos, mezzos, sopranos and coloraturas

Understanding the concepts of super belt (high belt), belt passaggio and the yell track

The relationship between legit voice and the belt voice

Introducing, "The Octave Rule: A Guide For How High You Should Belt"

Application to repertoire

Implications of the chosen song key

This workshop should include 2 singers, a mezzo and a soprano, and an accompanist.

Richard Lissemore, B.A., M.M., Voice teacher and performance coach, Lissemore Music Studios, 495 Fort Washington Avenue NY, NY 10033

**Run-through of Complete Vocal Technique With a Special Focus on Rough Singing and Vocal Effects and How to Perform Them in a Healthy Way**

'Complete Vocal Technique' (CVT) is the fastest growing vocal technique method in Europe. Cathrine Sadolin, the founder of CVT, will in this workshop make a run-through of the techniques with a focus on rough singing like Curbing, Overdrive, Edge and effects like distortion, growl, grunt, creak, rattle, screams and especially how to perform these sounds in a healthy way. The audience will be involved in trying out the different sounds.

CVT offers a radically new approach to singing and speech. All voice sounds are categorized as one of four vocal modes: Neutral, Curbing, Overdrive or Edge. By combining the modes with sound color and effects the singer/speaker can produce all sounds in a healthy way. Test studies and experience shows that distinguishing the modes can be learned in a few hours. In CVT the teacher is solely a servant to the artist and is therefore not mixing taste and technique. The CVT teacher uses concrete directions and precise terminology and teach any sound in any style.

CVT is spreading fast. Since the opening of 'Complete Vocal Institute' in Copenhagen in August 2005, more than 1.200 professional and semi-professional singers from 35 countries have been attending a longer education. Today there are 130 Authorized CVT Teachers in 24 countries, and 130 more are under education, making a total of 260 Authorized CVT Teachers in 2014.

CVT is described in Cathrine Sadolin's bestselling book "Complete Vocal Technique", now available in 7 languages.

Cathrine Sadolin, Professor, head of Complete Vocal Institute, Complete Vocal Institute, Hausergade 3,5, 1128 Copenhagen DK, Europe

### **Sound Sensations: Embodying Your Speech**

Public speakers, teachers, and anyone wishing to communicate with greater clarity of speech, *this workshop is for you*. Experience speech training in a uniquely physical and fun way. Discover the directness, intentionality, and energy of expression imbued in the vowels and consonants of American English. Establish physical and psychological connections between the sound you make and the message you want heard. Learn using all your senses, not just your ears. Free yourself from muscular or emotional obstacles that may have blocked your learning in the past. Short texts will be provided for individual work in the latter part of the session.

Tom Marion, MFA Acting (Rutgers University), Assistant Professor  
York College (City University of New York), York College / CUNY | 94 - 20 Guy R., Brewer Blvd,  
Jamaica, NY 11451

**A Short Course in Habilitative Vocology**

An overview will be given of topics that constitute habilitative vocology, including principles of perceptual-motor learning, use of natural body rhythms and oscillators, modulation of voice with prosody and articulation, compliance and concordance, exercise of laryngeal tissues, and source-vocal tract interaction.

Ingo R. Titze, Ph.D. , National Center for Voice and Speech, The University of Utah, Salt Lake City, UT 84101, The University of Iowa, Department of Communication Sciences and Disorders, Iowa City, IA 52242

Katherine Verdolini Abbott, Ph.D., University of Pittsburgh, Communication Science and Disorders, Pittsburgh, PA 15260

**The Power of the Psoas Muscles for the Speaker**

Access, relax, and incorporate psoas muscles in vocal production. Discover the power of psoas muscles in providing vocal support. Explore the relationship between proper use of the psoas muscles and ease in rib-expansion. Exercises range from gentle to physically challenging: exercises for all levels of flexibility and strength. Please wear comfortable clothing and bring a short piece of memorized text (not mandatory). Participate and/or observe.

Donna Snow, University of Washington, BA / The American Conservatory Theater, MFA, Associate Professor of Voice & Acting, Theater Department / Temple University, 1301 W. Norris Street

Robert Kahn, Syracuse University, BFA / Temple University, MFA, Actor / Singer / Teacher  
Temple University, 1301 W. Norris Street

## **Integrated Manual Therapy and Self Care for the Broadway Singer**

This workshop will review the superficial and specific extrinsic anatomy of the neck and TMJ and their interrelationships to the intrinsic vocal apparatus which may lead to vocal dyphonia in the Broadway singer. Specific etiological mechanisms that are inherent in this population will be reviewed in relationship to minor as well as major muscle dysphonia that can lead to degradation of the singing voice.

Basic techniques in Dynatonic™ Muscle Balance program for the voice will be discussed in relation to muscle dysphonia. Specific exercises, stretches and self release techniques that can be easily taught to patients will be demonstrated. Integration of osteopathic and physical therapy manual therapy techniques will be discussed for treating patients with all levels of vocal dysphonia.

Sean P. Gallagher BFA, PT, CFP, CPT, EMT In house physical therapist to over 100 Broadway productions, Owner/Director Performing Arts Physical Therapy, 311 West 43<sup>rd</sup> Street. Suite 405 New York, NY 10036

## **The Breathing Body**

Breathing is movement, and the integrity of any movement is dependent upon the integrity of the body maps that govern it. While Body Mapping often begins with acquisition of intellectual knowledge about the body, the actual process of altering cortical representations of our physical self requires interested attention as well as experiential input through multiple senses. The physical branch of yoga, also known as hatha yoga, utilizes asanas, or postures, to strengthen the physical body and encourage inclusive attention. Combined, these two disciplines provides a powerful tool for revising and refining body maps.

This engaging interdisciplinary workshop explores the structures and movement of breathing through Body Mapping and yoga. Through the use of anatomical models and tactile exploration, participants will examine and begin to correct and refine their own neurological maps of the diaphragm, lungs, ribs, abdominal muscles and related structures. Following each Body Mapping segment, the group will be led through a series of yoga asanas that focus on the area under examination, providing kinesthetic feedback to the cerebral cortex and furthering the mapping process. Through this highly effective combination of cognitive and experiential learning, participants will be introduced to a new way of teaching breath management, gain insights into their current understanding of the respiratory system, and learn a method that can lead to improvement of all movement skills.

Bonnie Draina, MM, DMA, Musicians' Wellness Associate, University of Colorado at Boulder  
301 UCB, College of Music, Boulder CO 80309

Suzanne Jackson, MM, Director, YogaSing, 284 Longview Lane, Kennett Square, PA 19392



## Pilates2Voice®: A New Mind-Body Technique for Voice Professionals

The Pilates2Voice® technique presents new training and diagnostic tools that result in improved strength and stamina for high-level voice performance. Pilates2Voice® is an innovative, proven mind-body technique that integrates Pilates and voice training methods. It is based on the dissertation, “The Olympic Singer: Integrating Pilates Training into the Voice Studio.” Voice Professionals who practice Pilates2Voice® see improved posture, breath management, mind-body conditioning, vocal range, resonance and articulation.

Pilates2Voice® uses a system of physical exercises that dictate a mind-body sequence, improving access to a performer’s power source for peak vocal performance. Pilates2Voice® is unique in that it also introduces voicing during the physical exercises. This allows monitoring of the degree of recruitment of the deep proprioceptive ‘core’ muscles. Appropriate recruitment is associated with optimal breath management and healthy vocal production. In this way, Pilates2Voice® helps to prevent potential overuse vocal injury.

Discussion and demonstration of Pilates2Voice® Routine.

- (a) Description of the three [3] MIND-BODY SEQUENCES with target goals involving the primary and secondary body muscles that are fundamental for an optimal vocal performance.
  - (b) Explanation for determining level of performance.
    - (1) *Basic Sequence*: focusing on Posture and Jaw-Release, Volition and Respiration
    - (2) *Intermediate Sequence*: adding a focus on Phonation
    - (3) *Advanced Sequence*: adding a focus on the articulators and their relation to Vocal Resonation and Articulation
  - (c) Hands-on demonstration of mat repertoire exercises with props.
    - POSITIONS: (a) half-lotus seated position (b) lying down Pilates2Voice® starting position
    - (c) sitting position [chair] (d) standing position
- \* Full audience participation for seated and standing positions.

Veera Asher, DMA, Creator of Pilates2Voice®, Inspire 2 Inspire LLC [including Performing Arts R & D (Hybrid-Performing-Artist™, Santa Monica, CA, (310) 584-7520, 702-445-8889, Veera@inspire2inspire.com or DrVeera@Pilates2Voice.com

## The Muscle of Presence

Presence is why we are so drawn to great performers, world-class communicators and inspiring teachers. And it all begins with the breath...

Breaking down the elements of what creates the phenomenon of presence and this provides us with specific skills that can be trained and exercised like any other performance technique.

In this workshop we will explore the elements of presence: We will cover a vocal approach that resides in released breath and authentic sound. Learning to literally breathe and share a space with others outside of one's judgments, thoughts, or preconceptions is a muscle that can be built, massaged, and worked until it becomes a reliable part of our approach as public performers or speakers.

This new approach has been in development for over 10 years at the NYU Graduate Acting Program under the guidance of Scott Miller and the Miller Voice Method Studio. We are excited to continue this exploration with audience participation (or with actors) as we do exercises which encourages

1. Unmanipulated breath,
2. Authentic sound,
3. Speaking with a point of view while active in the reality of doing.

Scott Miller, JD, Professor, Graduate Acting Program, Tisch School of the Arts, New York University, Miller Voice Method Studio , 336 E. 13th St. Ste. F2, New York, NY 10003 – 5839

## Sing Like You Speak

Sing Like You Speak™ workshops teach techniques for simple, natural, consistently professional vocals.

This is not traditional vocal training. Sing Like You Speak™ is based on the fact that the body is a perfect musical instrument and is rooted in the latest vocal, medical and acoustical research. It is the only fully codified contemporary vocal method complete with Workbook, practice CDs, online training in the method as well as a certification program for voice teachers.

As emerging research improves our understanding of the acoustics and mechanics of the vocal apparatus, the rules of performance voice and singing blend into one voice. Physiologically the voice is one instrument – singing, speaking, laughing or crying. During this workshop you will be introduced to a new method that treats it all aspects of vocal production same by using one technique to train the voice's enormous range of abilities.

Techniques covered:

- Breathe with ease diaphragmatically
- Improve vocal quality and pitch accuracy
- Increase range – up and down
- Intimate connection with audience
- Healthy belt

Presented by vocal trainer and author, Sally Morgan will show you the first steps to developing a vocal instrument flexible enough to respond to the demands of character, communication and content with the strength and vulnerability to bond with the audience.

Sally Morgan, Sing Like You Speak and, Vocal Power Tools Private Voice Studios

**Laryngeal Position in Singing: Strategies and techniques for maintaining a low, relaxed laryngeal posture in classical singing**

Vocal pedagogy texts, almost without exception, cite a low, relaxed laryngeal position as one of the fundamental components for a healthy, successful singing technique. This position occurs naturally when the larynx descends during inhalation. Provided there is no extraneous muscular action, such as that of a depressed tongue or over-extended jaw, phonation that occurs within this descended laryngeal posture not only yields optimal resonance, it represents a balanced muscular state ideal for optimal vocal production.

Attaining this posture can be an elusive task, with difficulty increasing as the pitch ascends. It is important that the singing teacher be equipped with a large variety of methods that dissuade the singer's natural tendency to recruit inappropriate muscles to "assist" with phonation, as this often causes laryngeal elevation and tension. Also important are various approaches to developing the independent function of the depressor muscles, which are especially necessary in the upper parts of the singer's range. The proposed workshop will include instruction and demonstration for a variety of approaches that encourage an optimal laryngeal position in singing.

*Support for presentation:*  
Demonstration singers.

Carla LeFevre, DMA, Associate Professor of Voice, University of North Carolina-Greensboro  
Greensboro, NC

## Music as Theatre: Tools of Characterization for the Classical Singing Studio

The concept of communicating drama through the singing voice has been viewed by most authorities as an inherent part of classical singing. However, with necessary concentration on technique, diction, style, and varied literature in the singing studio, there is often less time available to address characterization.

In this workshop, 2 singers, \*\* their pianists, and the class as a whole, will explore one method (inspired by Uta Haagen, Wesley Balk, Stanislavsky, Cohen, etc.) that may help singers and their teachers develop expressive characterization through animal imagery touchstones. Each singer will engage in exercises involving discovery without sound, demonstration with text alone, and finally, exploration through sung phrases of music:

I. If your character were a mammal, what would it be?

How would it stand?

How would it walk?

How would it sit?

II. If your character were a sea creature (fish, crustacean, etc.), what would it be?

How would it find food?

How would it eat?

How would it protect itself?

III. If your character were a reptile, what would it be?

How smoothly would it move?

How fast would it move?

How quickly would it react?

IV. If your character were a bird, what would it be?

Where would it nest?

What would it eat?

What relationship would it have with other birds?

Upon completion of these exercises, it is also common to perceive vocal benefits in intonation, timbre, and musicality when the singer performs again.

Kathryn Barnes-Burroughs, D.M.A., Director, Southern Institute for the Performing Voice,  
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**The Singing Voice Specialist (SVS) as Master “Chef”: Creating an Individualized Vocalise “Recipe” Protocol for the Vocally Injured Singer**

In the collaboration team of voice teacher, speech-language pathologist and physician, the voice teacher is perhaps the most critical collaborator due to the ongoing nature of the relationship with his/her student. The teacher and student who have built a relationship of trust and respect should be able to continue working together when and if vocal injury occurs, especially if the voice teacher is prepared with adequate rehabilitative pedagogical methods. Because rehabilitative techniques are not always a part of voice pedagogy courses in most university training, a teacher may seek out workshops, courses in speech pathology, and/or collaborative rehabilitative training internships to bolster his/her knowledge of therapeutic techniques.

The presenter of this presentation possesses a doctoral degree in voice and is also degreed in speech pathology and is author of *Singing Voice Rehabilitation: A Guide for the Voice Teacher and Speech-Language Pathologist* (2010 DelMar Cengage Press). She will briefly review physiology of normal voice function, and describe some common vocal disorders of singers. Evaluation measures and documentation, as well as suggested vocal recovery schedules and specific combinations (“recipes”) of vocalizes for various types of disorders will be discussed and demonstrated. In addition, specific therapeutic song repertoire choices and vocal hygiene recommendations for the injured singer will be discussed.

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**There's an App for That: Using free and inexpensive technologies in the voice clinic or studio**

Those working in the field of voice may wish to explore free and inexpensive technologies to record, analyze, and transmit voice activities. However, limitations of time and expertise with electronics may be prohibitive. This workshop will take the research time out of the equation and will bring myriad technologies available for use in the voice clinic or studio to the practitioner for hands-on manipulation.

Workshop participants will be introduced to technologies in three categories: a) Free, b) Under \$50, and c) \$50-\$100 that will be useful in the voice clinic or studio. These will include microphones, software for voice analysis, hardware for voice recording, smart phone applications and software for recording audio/video of therapeutic/lesson activities to augment home practice, and methods to facilitate transfer of audio/video files. Participants will have the opportunity to experiment hands-on with the technologies, using equipment supplied by the presenter.

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Bryn Olson, MS, Speech Pathologist, Ohio ENT, 4300 Clime Road, Suite 100, Columbus, OH 43228

## **Respiratory and Laryngeal-Control Therapy for Treatment of Paradoxical Vocal Fold Motion (PVFM)**

PVFM is a nonorganic disorder of the larynx that involves unintentional paradoxical adduction of the vocal folds, causing episodic airway obstruction. A key component of treatment involves behavioral therapy. In this workshop we will discuss etiological factors (precipitating and maintaining), as well as differential diagnosis, and goals for management of patients with chemically-induced or exercise-induced PVFM. But primarily, I will focus on specific breathing and laryngeal exercises that I have developed to manage symptoms of PVFM. This therapeutic approach goes beyond the basics (such as establishment of abdominal breathing and slow nasal breath). There will be demonstrations of effective and specific respiratory and laryngeal exercise routines that allow patients to reduce the frequency and length of PVFM episodes, and ultimately control symptoms until normal breathing behavior is restored, and a complete resolution of the condition is achieved.

Topics include:

- Identification of inefficient breathing patterns
- Identification of paradoxical abdominal movement
- Development of abdominal breath control
- Development of more advanced breathing control practices, with the use of respiratory ratios, progressive slow breathing, modification of air-hunger threshold.
- Use of “rescue breathing” exercise
- Development of glottic awareness and glottic control practices
- Modifications to use by patients with exercise induced PVFM

Attendees to the workshop are expected to have basic knowledge of PVFM. There will be hands-on practice, with the use of a volunteer to demonstrate use of techniques, as well as exercise practice by all attendees. The final part of the workshop will involve sharing with participants the actual course of management undertaken with patients and comparing it with ideas generated from dialogue with the audience.

Claudio F. Milstein, PhD, Associate Professor, Cleveland Clinic, 9500 Euclid Ave. - Desk A71



**Shaken, Not Stirred: Practical Exercises to Address Difficulties with Vibrato**

Vibrato and non-vibrato singing are used in music around the world. For some singers, developing and maintaining a consistent vibrato is problematic. Practical suggestions for addressing vibrato issues will be presented. These suggestions will include (1) trill exercises; (2) exercises which alternate moving and sustained patterns; (3) agility exercises; (4) coloratura exercises; (5) flowing movements, as found in Tai Chi; (5) tactile feedback and (6) visual feedback using a voice analysis program. A short question and answer session will follow.

John Nix, M.M., M.M.E., Associate Professor of Voice and Voice Pedagogy, The University of Texas-San Antonio, 1 UTSA Circle

### **Treatment of Paradoxical Vocal Fold Motion in Adolescent Athletes: Sport-specific Strategies for Recovery**

Paradoxical vocal fold motion (PVFM), also known as vocal cord dysfunction, is a laryngeal disorder in which the vocal folds adduct inappropriately during inhalation and sometimes during exhalation. In children and adolescents, it occurs most often with exercise, and is often misdiagnosed and treated as exercise induced asthma. The gold standard of treatment for PVFM is therapy by a speech-language pathologist, and includes training of breathing techniques to open the vocal folds and maintain an open airway. These exercises to promote vocal fold abduction during an attack are documented in the literature, and are effective in preventing or stopping an attack. High-achieving adolescent athletes require activity-specific strategies and training during these activities to allow them to return to their previous competitive level in their sport.

In this workshop, I will review the basic principles for treatment of PVFM. I will then discuss the sport-specific challenges and ways to address them, focusing on the sports seen most often in our practice: Cross country, track, swimming, football, soccer, hockey and basketball.

Participants will learn how to adapt breathing strategies to these various sports, with consideration of the unique demands of each sport. We will also discuss the role of stress and anxiety, especially related to competition, in this population. Participants will have opportunities to practice techniques individually and with others, and there will be time for discussion of particularly challenging cases at the end.

Maia Braden, MS, CCC-SLP, Speech-Language Pathologist, University of Wisconsin – Madison,  
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**How to Train Lip Trills, Raspberries and Other Semi-occluded  
Vocal Tract Postures**

This discussion will focus on how to teach someone how to perform many of the semi-occluded vocal tract postures, including the lip trill, raspberry (upper and lower lip), tongue trill, nose pinch, and standing wave (a device employed by the late Dr. Barbara Doscher). Based on information gathered over two decades of teaching voice, this talk will cover common challenges experienced by singers attempting to employ these voice training tools as well as specific training techniques used to elicit their most effective application. In addition to a sharing of ideas, the discussion will include many live examples of training of interested participants.

Brian P Gill, DMA and Certificate of Vocology, Music Assistant Professor/Associate Director for Vocal Pedagogy, New York University, 35 West 4th street Suite 777 NY, NY 10012

### **Feedback from the EGG Signal in the Singing Voice Studio**

The EGG signal remains a potentially powerful, but underutilized, means of non-invasive feedback for training the singing voice. Primarily, but not solely, through revealing the closed quotient, it can give essential information on registers, voice assessment (robustness of voice), voice onset and offset, and larynx stability. Obstacles to its wider use by singing teachers are principally cost and the difficulty of reliably obtaining and interpreting the signals.

This workshop will discuss the EGG signal generically, but use VoceVista software in displaying the signals. After a short introduction, most of the time will be spent examining and interpreting the EGG signals of volunteers among the participants.

Note 1: The proposal is clearly contingent upon whether a projector (or large monitor) for a computer can be available, since this would be the only means for displaying the feedback signals to more than a few people.

Note 2: The fact that the presenter offers for sale the software, as well as the EGGs, brings up an obvious potential conflict of interest. I would have to be trusted to give the information in a general way, rather than emphasizing the advantages of any particular brand.

Donald Miller, Groningen Voice Research, Stavangerweg 21-2, 9723JC Groningen, The Netherlands

## **Adapted Yoga Techniques for Voice Therapy and Singing Voice Rehabilitation**

Voice clients often present with sub-optimal motor behaviors that negatively impact effective integration of respiration, phonation and articulation in their speech and/or singing. Improving voice production requires therapeutic approaches that can appropriately and effectively target a client's specific challenges. These may include structural weakness/tension/imbalance, sub-optimal respiration patterning, physical energy, or self-awareness.

Adapted yoga techniques can be effective holistic tools for addressing these challenges. They emphasize the integration of mindfulness - attention to sensory/emotional attributes - with training tasks in movement, breathing, and voicing.

Adapted *asana* (moving in and out of or maintaining specific body postures) can strengthen weak muscle groups or facilitate relaxation and stretch of chronically contracted ("held") muscle groups. It can be especially helpful in developing optimal postural relationships of the head, neck, shoulders and torso.

Adapted breath work (*pranayama*) can be used to increase awareness and control of respiratory movement patterning, which can increase control of tidal volume and inhalatory and exhalatory flow rates. It is also a potent tool for managing negative stress response.

This workshop will provide a brief overview of the tools of yoga, then demonstrate examples of adapted yoga (movement and breath work with focused attention) for use in voice therapy and singing voice rehabilitation.

Kenneth Tom, Ph.D., CCC-SLP, RYT, Associate Professor, California State University Fullerton, Department of Human Communication Studies, 800 N. State College Boulevard, Fullerton CA 92831

**The Emotional Voice: Discovering Vocal Freedom through The Alba Technique**

Whether onstage or at the podium, our emotions effect our phonation. “The Affect effects the Effect.” Thus the ability to accurately observe within ourselves and correctly identify our emotional states is the beginning of the freedom of vocal control in public situations.

Alba Emoting™ is a neuroscience-based method, which allows any person to experience universal human emotions through purely physiological means. Once mastered, Alba Emoting empowers the individual to control subjective responses to stimuli.

Through a visual demonstration, a brief explication of Dr. Susana Bloch-Arendt’s theory of the 6 core universal human emotions, 2 exercises of opposite emotions, instruction in The Step Out protocol (Neutral), and a moderated discussion of cognitive reflection upon the felt body experience, the workshop will give all participants a glimpse of the method through direct physical experience.

Patricia Angelin, MA, CLP5, CL5 SAG, AEA, Founding Instructor, Alba Technique NY, 139 West 28<sup>th</sup> Street, Suite 3E, New York, NY 10001

### **A Collaborative Approach to Tongue and Jaw Tension**

Voice Teacher Martha Randall, Physical Therapist Jodi Barth, and PTA Gincy Stezar collaborate to address muscular imbalances caused by forward head position and tongue and jaw tension. Exercises include tongue stretches in addition to the ones commonly employed, and the use of the Nuk brush to release tension in the internal pterygoid and increase jaw mobility. Workshop participants will have the opportunity to do the exercises and Nuk brushes will be supplied. One or two singers will be given individual attention for the benefit of the class and handouts will describe the exercises used, explaining what the voice teacher can safely and ethically do, and when to refer to a licensed physical therapist. This is a true synthesis of two different disciplines to add to pedagogical tools.

Martha Randall, BM, MM, Adjunct Graduate Faculty, University of Maryland  
NATS, President 2006-08, Member, American Academy of Teachers of Singing

Jodi Barth, BS, Regional Manager, NRH Regional Rehab, 6001 Montrose Rd., Ste. 101, Rockville  
MD 20852

Gincy Stezar, BS, AAS , Clinic Coordinator, NRH Regional Rehab, 6001 Montrose Rd., Ste. 101  
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### **Connecting the Actor and the Singer**

In the past few years, several books have been published on the subject of acting for singers, usually geared towards the operatic voice. Many universities have taken notice of the increased demand for singing actors and added acting training to vocal performance curricula. However, most of this work is isolated to the classroom and rarely crosses over into the studio. While musical theatre performers have almost always received formal acting training, they also often only address their voices from a technical point of view during their lessons. By addressing vocal issues through acting exercises and tying technical corrections into character choices, the voice teacher can often achieve faster results than through technical work alone. Conversations about acting can also help bridge the divide between the acting and voice faculty and serve as a basis for opening up conversations about training the overall performer and not just the voice.

This workshop will work with classical and music theatre singers to explore emotional and acting remedies to common vocal difficulties.

David Meyer, D.M., Associate Professor of Voice, Shenandoah Conservatory, 1460 University Ave, Winchester, VA 22601

Matthew Edwards, M.M., Assistant Professor of Voice, Shenandoah Conservatory, 1460 University Ave., Winchester, VA 22602



### **Posture For Singing, How And What Do We Teach?**

It is commonly assumed that posture is essential for optimal singing. Many clinicians and singing teachers stress 'ideal posture' in their teaching, insisting that the singer 'stand up straight, chin up, chest up, stomach in'. This 'ideal' however is not only static but does not allow for the dynamic movement involved in gesture, let alone moving around on stage. Good posture must be dynamic. It depends on the musculoskeletal coordination of the individual in movement. Imbalance leads to increased tension.

Marina Gilman MM, MA, CCC-SLP, Department of Otolaryngology Emory University, Speech-Language Pathology, The Emory Voice Center, 550 Peachtree Street NE, Suite 9/4400, Atlanta, Georgia 30308

**Go Figure: Estill Voice Training™ for the Voice Studio & Clinic**

Estill Voice Training™ (EVT) is a revolutionary method of teaching voice developed by Jo Estill that integrates pioneering scientific research with the artistic study of voice. The purpose of this Estill Voice Training workshop is to demonstrate select Figures for Voice Control™ and apply them to common problems encountered in the singing studio and singing voice therapy. Workshop participants will have the opportunity to produce the figures, describe the underlying anatomy and physiology, and apply them to drama, music, or voice therapy programs. The Figures for Voice are unique exercises that address power, source and filter properties of voice production, and include: retraction of the false vocal folds for healthy voice production; narrowing of the aryepiglottic sphincter for twang resonance in opera, belting, & the rehabilitation of hypofunctional voice disorders; and, changing vocal fold mass for register variation. Since an integral part of Estill Voice Training is the connection of the sound of the figures to the acoustic image in the spectrogram, participants also will learn how a customized acoustic program is used as a visual feedback tool. Participants are encouraged to volunteer their voices, teaching and/or therapy challenges during the session.

Kimberly Steinhauer, PhD, President, Estill Voice International, 55 Standish Blvd

Mary McDonald Klimek, MM, MS-CCC/SLP, Vice President, Estill Voice International, 55 Standish Blvd

**Training “Mr. Soprano” and “Ms. Tenor” – Gender-Neutral Voice Pedagogy**

The vocal sounds human beings make are more the result of gender and cultural bias rather than physiologic function. The human larynx is, for all intents and purposes, a gender-neutral instrument: males and females can produce similar sounds with similar component parts. Training the whole voice is simply good voice pedagogy. Limiting pedagogy to males making “male sounds” and females making “female sounds” is not. In this workshop, the author will briefly state the case for gender-neutral voice pedagogy. He will then work with male and female singers to help them explore, in both technique and repertoire, the totality of their voice free of gender, cultural, and tribal restrictions. Question and answer time will be included in the presentation.

Robert Edwin, BA, Assoc. Editor, NATS Journal of Singing, Independent Singing Teacher, 1509 Glenview Drive, Cinnaminson, NJ 08077-2156

**The Voice Sleuth - Voice and Forensics**

This half-day seminar addresses the field of Forensic Voice or Forensic Phonetics. Expert presenters will focus on Forensic Voice Identification with 1) a basic description of the process, 2) examples, and 3) the unique challenges it encompasses. Knowledge from fields as diverse as human behavior and computer modeling will be reviewed as they contribute to the success of Voice Forensics. Other disciplines to be considered are the nature of decoding and the detection of certain human behaviors from analysis of voice. Three such examples are stress, deception, and intoxication. The effects of psychological stress on voice production will be contrasted with stress resulting from threats against a person. Caveats and limitations from work based on deception will be highlighted given that electronic devices that have not been suitably researched are widely used.

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Harry Hollien, Ph.D., Professor Emeritus Of Linguistics, Speech and Criminal Justice, University of Florida, Gainesville, FL

Malcolm Brenner, Ph.D., Senior Human Performance Investigator, National Transportation Safety Board 490 L'Enfant Plaza SW, 490 L'Enfant Plaza SW, Washington D.C. 20594-0003

Ruth Huntley Bahr, Ph.D., Professor (Experimental Phonetics, Phonology, Voice, Forensic Communication, Literacy), Director, Speech-Languages and Pathology Graduate Program Communication Sciences and Disorders, 4202 E. Fowler Ave, PCD 4024 , University of South Florida

## Flow Glottogram Characteristics and Perceived Degree of Phonatory Pressedness

In the past some attempts have been made to identify signs of phonatory pressedness in flow glottograms, which were derived from mask recordings of the flow signal. The analysis was quite tedious and the subjects had to phonate into a flow mask. Today, the means of deriving flow glottograms have improved considerably. The aim of the present study was to investigate the relationship between mean ratings of perceived pressedness, obtained from a test with expert listeners, and voice source characteristics, derived from inverse filtering the audio signal by means of the Decap software (Granqvist). Audio, electroglottogram and subglottal pressure, estimated from oral pressure during /p/ occlusion, were recorded from six female and six male subjects, who phonated the syllable /pae/ at three loudnesses and three pitches in three types of phonation: neutral, flow, and pressed. Closed quotient, dominance of the voice source fundamental, normalized amplitude quotient, peak-to-peak flow amplitude, as well as formant frequencies and the alpha ratio of spectrum energy above and below 1000 Hz will be analyzed and compared with the perceptual data. In addition, the correlation between the flow glottogram parameters analyzed will be examined. The results should provide a basis for future development of methods for measuring degree of pressedness from the audio signal.

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## **Voice Therapy and Physiologic Effects: Can We Do More than Change Behavior?**

### **Purpose**

Traditional voice therapy has the aim of behavioral changes in the function of a voice, and education on how best to make use of a person's voice. Investigations into the effects of mechanical and sensory stimuli to the vocal folds and other tissues indicate that physiologic changes can be expected as well. This review presents findings from research in allied areas and animal models that show such effects.

### **Method**

A review of published basic science and clinical studies of human larynges, animal models, and in allied rehabilitation areas was used to determine the current level of evidence for the use of therapy to affect changes in tissues, muscles, and neurological properties related to the voice.

### **Results**

Areas with the greatest possibility of affect include; 1. scar resolution, 2. ordered re-organization of cover layers of the vocal folds, 3. increases in muscle mass, 4. changes in muscle fiber proportions, and 5. desensitization of laryngeal afferent reflexes that may affect the laryngeal adductor response. Human studies, animal models, and translational research in these areas show evidence of predictably controlled changes in physiology as the result of active voice therapy.

### **Significance**

Basic science studies are already progressing in several of these areas. Clinical studies can simultaneously present evidence for the changes that are hypothesized to occur from therapy interventions. Close collaboration between basic and clinical arenas will greatly accelerate our understanding of the mechanisms and processes involved in this area of intervention.

Daniel McCabe, DMA, CCC-SLP, Chief Vocologist, Eugen Grabscheid Voice Center

Kenneth W. Altman, MD, PhD, FACS, Director, Eugen Grabscheid Voice Center, Associate Professor of Otolaryngology, Mount Sinai School of Medicine.

## The Electroglottographic Spectrum as an Indicator of Phonatory Activity

Although the electroglottographic (EGG) signal is not acoustic, one might expect that some of the source-induced variation in the spectrum slope of the airborne signal would be present also in the EGG signal. Wideband spectra of EGG signals were evaluated from sustained and intermittent phonation under various conditions, including changes of electrode position, vowel, subglottal pressure and SPL. Recordings were made of subjects producing /pV/ utterances with simultaneous acquisition of EGG and intraoral pressure. The EGG spectrum envelope was found to be quite linear in dB/octave, with the exception of the fundamental partial. The EGG spectrum effects of vowel changes were negligible. EGG spectrum slope change with SPL was large at phonation onset and small in loud phonation. Additionally, recordings from an existing database of 8 trained male singers were analysed for EGG spectrum variation with SPL. The singers performed crescendo tasks on sustained tones, with a typical SPL variation of up to 20 dB from soft to loud. The corresponding EGG spectra had slopes of -14 to -9 dB/octave. The variation in EGG spectrum slope was again small, on the order of one quarter of the slope variation in the airborne spectrum. Occasionally, ripple in the EGG spectrum envelope was present, due to double peaks in the time derivative of the closing part of the EGG waveform. We conclude that the EGG spectrum slope appears to offer a convenient contacting criterion, but will be harder to use for judging vocal effort beyond contacting.

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Andreas Selamtzis

## **Type IIB Thyroplasty for Phonic Tics in a Pediatric Patient with Autism Spectrum Disorder: A Case Report**

Autism spectrum disorders (ASDs) are commonly associated with tics including chronic motor tics, vocal tics and Tourette Syndrome (TS). A tic is defined as sudden, brief, involuntary motor (motor tics) or sounds (vocal or phonic tics). We present a case report of a 13-year old boy with ASD and vocal tics. Vocal tic frequency was nearly 2000 per day and 90 decibels in volume. He presented to our Laryngology Clinic after multiple failed attempts of medical management vocal fold and botulinum toxin injection to help reduce the frequency and volume of these tics. Following evaluation in our clinic, we recommended a lateralization (type IIB) thyroplasty. An autologous cartilage graft from the thyroid ala was used and held in place with a bioresorbable mesh. Using 4-0 prolene sutures the mesh was secured in place. The operation was well tolerated, with minimal signs of aspiration and he was discharged to his home within 48 hours. At 5-months post-operatively there was 50% reduction in tic frequency and intensity. Additionally, he has shown improved ability to converse with his peers and has improved nutritional status. This case demonstrates that alteration of laryngeal geometry could serve as a site of intervention for intractable vocal tics in patients with ASD and TS. Moreover, bioresorbable mesh for type IIB thyroplasty may overcome common challenges associated with titanium plates not only for this particular indication but also for other laryngeal reconstructive applications.

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